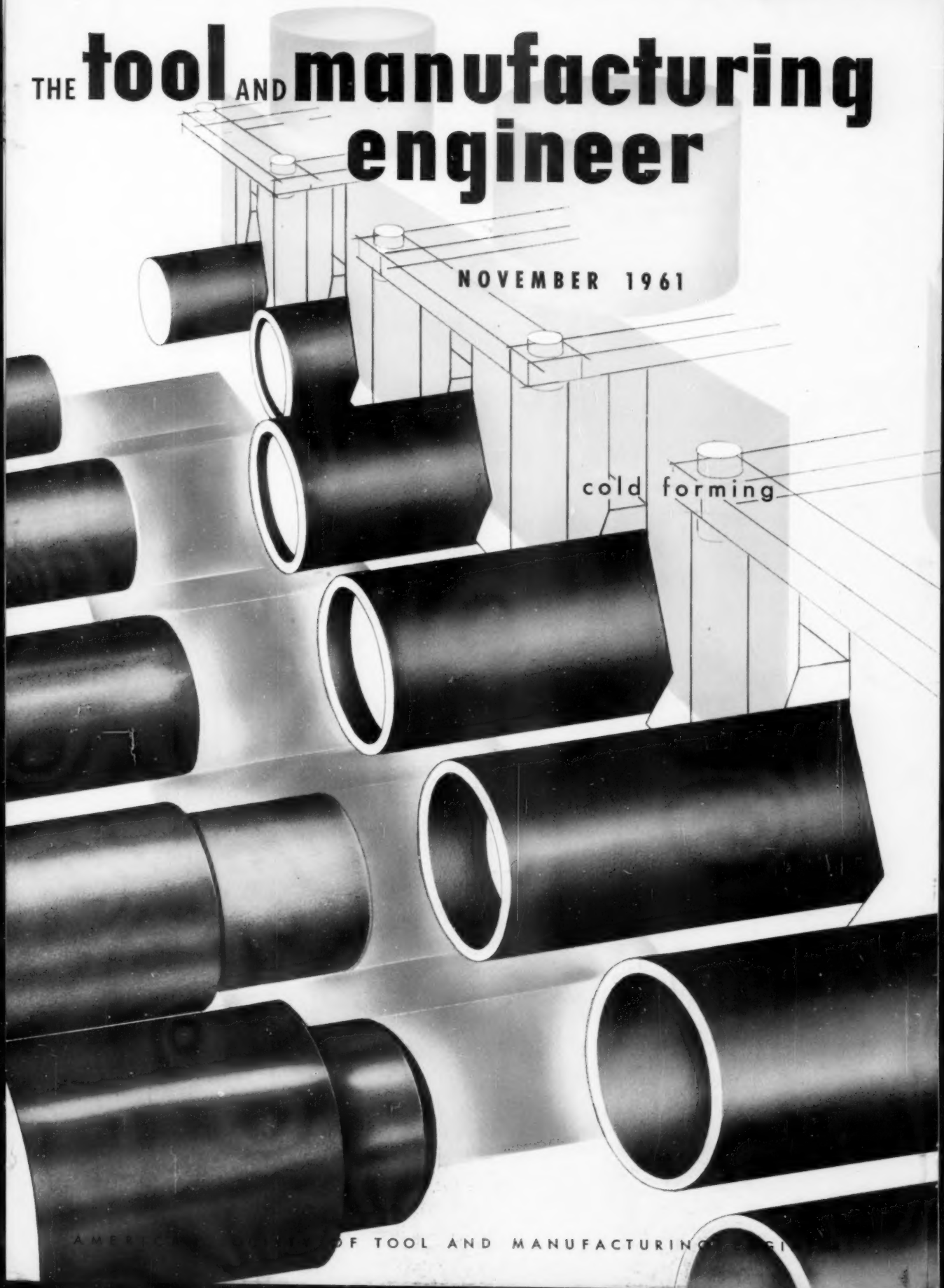
THE tool AND manufacturing engineer

NOVEMBER 1961

cold forming



AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINEERS

THE NEW "A" BORE-MATICS

Completely new machine design from base to bridges for versatility, capacity and ease of maintenance.

by Albert A. Arbogast

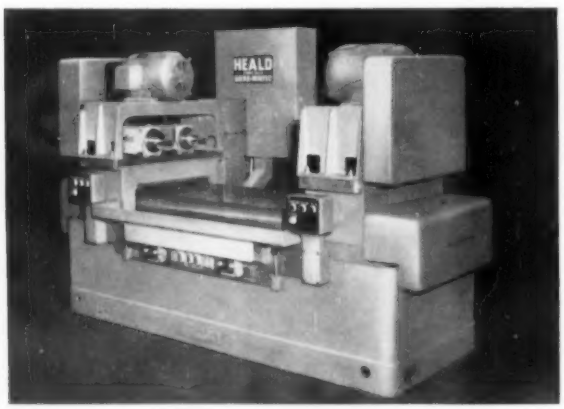
Manager, Bore-Matic Machine Division
The Heald Machine Company

What is the basic philosophy behind the new "A" series line of Bore-Matics? That's a good question—and a simple one to answer because the basic motivating factor was "simplicity" itself. For in almost every case the basic new design feature in this new Bore-Matic line makes them *easier* to set up, *easier* to change over, *easier* to operate and *easier* on service inspection. All this has been accomplished while still maintaining our continual trend toward higher standards of accuracy and precision.

Take the new machine bridges, for example. Within a given size of machine, bridges are removable and interchangeable. Furthermore if a user has a single-end version of a new "A" Bore-Matic he can readily convert it to a double-end unit by adding a second bridge, boringheads, drive, and associated cycle and hydraulic equipment.

Bridge pads and tee slots are provided at both ends of all machines in each of three size ranges. Bridge setback is infinitely adjustable within its range, too—permitting wider latitude for tooling and fixture design and minimum rapid traverse time. New bridge location has also substantially increased the workholding capacity of these standard machines.

Manifold hydraulic transfer plates and valves that used to be inside the base cavity are now mounted externally on a separate panel at the rear where they are more easily accessible—such a location also isolates a heat source from the machine base contributing to uniform precision throughout longest production runs.



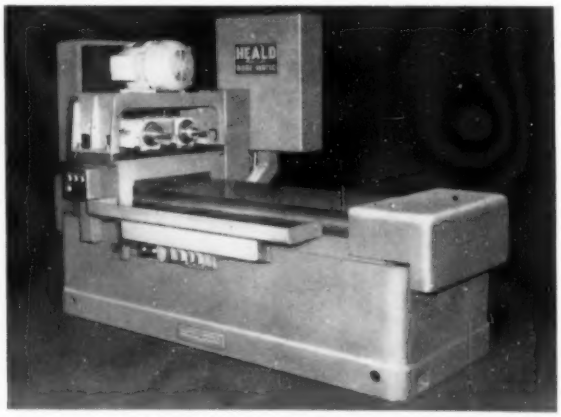
The hydraulic power unit has also been located separately from the base at the rear of the machine, for ease of access and elimination of thermal distortion.

The machine table is larger, heavier and travels on hardened and ground box type ways with hold downs—such construction assures maximum accuracy of table travel.

The new model Bore-Matics are now available in three basic "A" machine sizes—2, 3 & 4—each of which can be furnished as either single or double end machines.

Capacities of the new "A" series Bore-Matics are shown in the following table:

	222A	322A	422A
Width of Bridge	31"	34"	38"
Distance between Bridges (adj.)	16"-36"	24"-43"	30"-54"
Table travel	15" or 18"	20"	25"
Table Pad Dimension	14" x 55"	18" x 64"	24" x 80"



Above, Model 424A, single end version of the size 4 type Bore-Matic; bridge, heads, drive equipment, etc. on left end only.

At left, 422A, double end version of the size 4 type Bore-Matic; bridges, heads, drive equipment, etc. on both ends of machine.

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THE tool AND manufacturing engineer

November 1961 Vol. 47, No. 5

Training Manufacturing Engineers—In-Plant Program Pays Off ..... *By T. W. Black* 81

Graduate mechanical engineers are being turned into top-notch manufacturing engineers by company-sponsored training programs.

Gadgets 86

Fixture centers steel ball for drilling . . . steadyrest supports multisided work . . . collar eliminates backlash error . . . quenching tool ups quality.

Don't Reject Those Good Parts ..... *By Edward S. Roth* 89

Acceptance gages sometimes reject acceptable parts. There are five ways to reduce this unnecessary waste.

Calibrate Surface Plates the Easy Way ..... *By T. N. Busch* 92

When surface plates are calibrated in the shop, many measurements and calculations are ordinarily needed. A new method is much faster.

Designed for Production 96

Boring head cuts machining time on castings . . . tape-controlled grinding machine finishes rolls faster . . . gear honer has four motions.

Principles of Cold Forming—Part 1 ..... *By Daniel B. Dallas* 101

A switch to cold forming from some other process can lead to savings—if the part design lends itself to cold forming. Here are some pro's and con's.

Tools at Work 108

Precision drilling of aluminum . . . fast turning of ring gear forgings . . . big sphere fabricated for submarine . . . automatic metallizing of tools.

Standard Dimensioning for Jig Bore Drawings ..... *By Harold H. Poett, Andy Incardona* 113

When drawings are dimensioned with the machine operator in mind, boring is faster and there are fewer chances for costly errors.

Plastics Cold Formed in Metalworking Presses ..... *By Francis M. Mallee* 116

Polycarbonate resin sheet has high ductility, which means that it can be stamped and drawn as readily as low-carbon steel.

Development of Right Regular Cone Blanks (Reference Sheet) ..... *By M. W. Loftus* 117

Simple formulas can be used to show the amount of material needed to economically produce cone blanks from sheets or strip.

ASTME IN ACTION—Seminar Spurs Space Race 119

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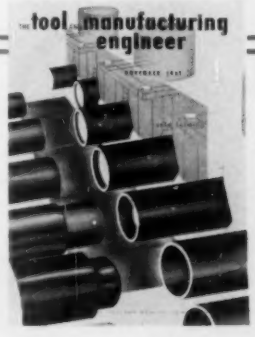
THIS MONTH'S COVER

In cold forming, parts are formed to finished tolerances from a solid slug of metal in a series of dies. Here the cover artist shows a progressive cold forming die in action. After each hit of the press, the partially formed parts are carried into the next station automatically by a transfer mechanism. Forming is continuous, automatic and extremely fast. Cold forming is the subject of the article starting on page 101, the first of a series.



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Is Science Overemphasized?

This year, as for the past several years, freshman enrollment in American engineering schools has dropped. Some educators feel that part of this drop can be attributed to the Post-Sputnik emphasis on science. Science has been glamorized, the need for scientists has been emphasized. Consequently, potential engineers tend to major in science, rather than engineering.

Science, strictly speaking, is an activity devoted to the discovery of the fundamental nature of things—the study of the atomic nucleus, the study of life—in short, the study of the nature of the universe, living and nonliving. The objective of the scientist is to find the basic laws of the universe.

Engineers apply those natural laws. Rocket design engineers, for example, work with the laws of mathematics, physics, chemistry and other sciences in order to develop a suitable propulsion system and capsule for a manned shot to the moon. Other engineers—called manufacturing engineers—take the blueprints and plan the manufacturing processes that ultimately make the plans of the rocket design engineer a reality.

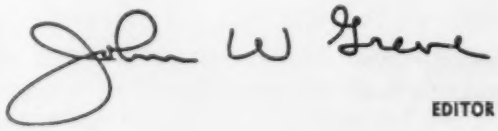
All of these engineers must, of course, have scientific training—they must understand the scientific laws they apply—and scientists are often assigned to engineering projects. But for every "pure" scientist who is needed by a large project dozens and even hundreds of engineers are needed to carry the project out.

Moreover, those engineers require a broader knowledge than was required twenty years ago or even five years ago. New scientific discoveries are being made at an accelerating rate. The progress of technology has been even more rapid. Yesterday's solutions to engineering problems may be out of date today.

Greater numbers of engineers are needed to keep America technologically strong. But mere numbers of engineers are not enough. America's real engineering shortage is not in numbers—it is a shortage of really talented, well educated and highly productive engineers.

These are the men on whom the future of our technological nation depends. And it is to be hoped that the present emphasis on the importance of science will not divert too many potential engineers into science.

Scientific discoveries are of merely academic interest until engineers put them into action for the benefit of mankind.



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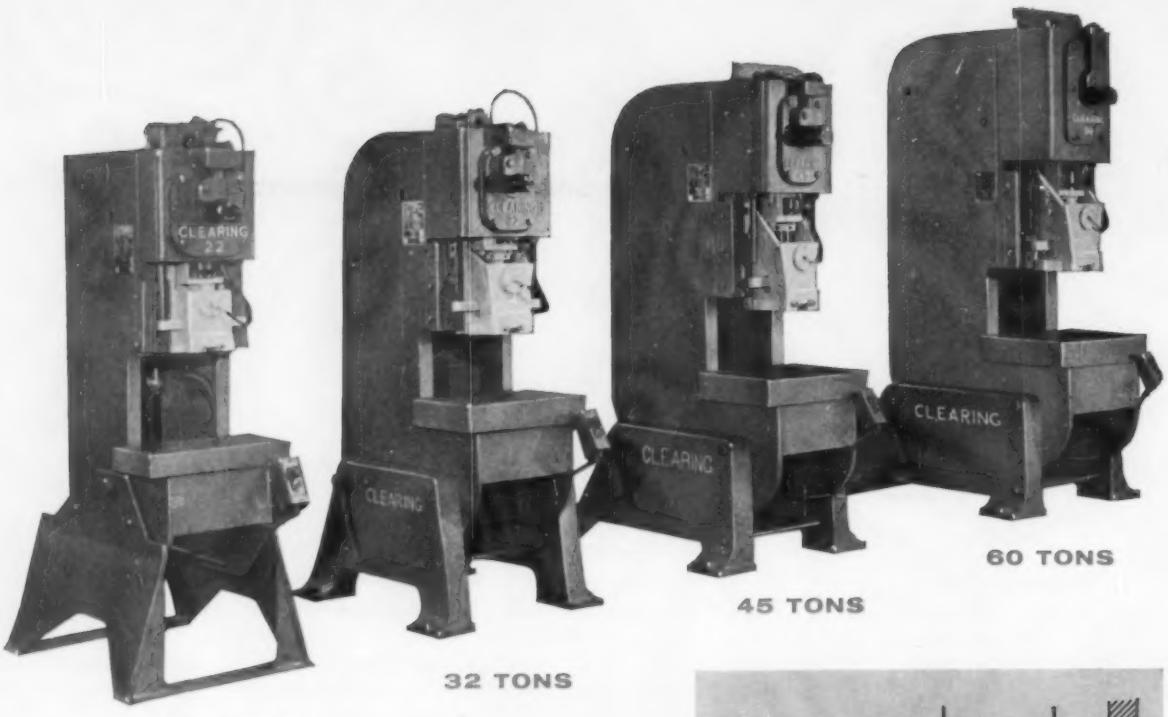
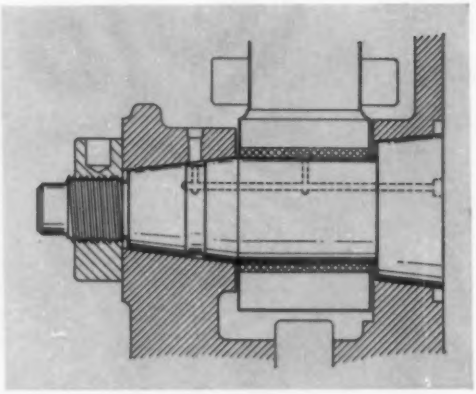


The Clearelease mechanism makes it possible to unstick the press in a matter of minutes. A taper wrist-pin in the press slide provides instant release. Simply loosen locking nut and tap wrist-pin in.



No Fear of Getting Stuck With a Clearing Torc-Pac

"Sticking" a press is a problem that can send a production manager to the nurse for tranquilizers, as you know. And presses **do** get stuck, let's face it. But here's what Clearing has done about it on the new Torc-Pac line of O.B.I.'s. "Clearelease", an ingenious mechanism built into the press slide makes it possible to unstick the press in a matter of minutes. It's simple and fast and the press is back in operation before tempers can rise.

There are a lot of improvements on the new Torc-Pac. A clutch and brake unit that is as quiet as it is maintenance-free is an important plus. Controls are shock mounted. The streamlined design of Torc-Pac conserves floor space. Feeding is easy from any direction. Find out more about the new Torc-Pac. Ask for literature today.

usi Clearing

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preview

. . . a fast look at this issue

Making Manufacturing Engineers Effective

Manufacturing engineers need to be familiar with nearly all aspects of their company's operations in order to plan production lines intelligently. Colleges and universities can't give this kind of training but a well-educated engineer can become a truly effective manufacturing engineer if he is given adequate training by the company that hires him. Informal on-the-job training is slow and sometimes incomplete. Warner Electric Brake & Clutch Co. uses a two-year, full-time program to train its manufacturing engineers. It finds that engineers who participate in the program are ready to take on real manufacturing engineering responsibilities sooner than engineers who have been trained informally. Details of the Warner Electric program are given in an article by Senior Associate Editor Ted Black, Page 81.

Making Good Parts Out of "Bad" Ones

Final acceptance gages always cause the rejection of some parts that would fit perfectly in assembly. Sandia Corp. engineer Edward S. Roth has done a lot of thinking about this deplorable situation and has come up with some answers—answers that he communicates to the readers of this magazine in an article starting on Page 89. He lists five ways to avoid the rejection of good parts and illustrates his ideas with easy-to-use tables and drawings.

Making Surface Plates Accurate

Accuracy of many parts and assemblies depends on the accuracies of the surface plates on which they are checked. It's not always practicable to return a surface plate to its manufacturer for calibration so most plants find it necessary to recalibrate their own surface plates in the plant. The usual calibration methods involve taking a great number of measurements and performing rather involved series of calculations to put the data in usable form. Ted Busch, DoAll Co. engineer, has developed a graphical method that takes much of the work out of surface plate calibration. Manufacturing engineers who have been looking for a faster, easier way to calibrate surface plates will find his article, Page 92, of unusual interest.

Making Cold-Formed Parts

Associate Editor Dan Dallas spent 17 years as a tool and die designer and tool company executive before joining the staff of the magazine three years ago. He is one of the Nation's foremost authorities on tools and dies—an authority who has actually solved hundreds of difficult design problems. Thus his series of articles on the principles of cold forming is impartial and authoritative. The first article starts on Page 101.

Making Holes With Standard Drawings

When the proper hole layout and appropriate tolerances are applied on all tooling and engineering drawings, maximum efficiency can be obtained from jig boring operations. Lockheed Missile & Space Div. engineers Harold H. Poett and Andy Incardona were instrumental in developing Lockheed's standardized dimensioning system for jig bore drawings. Their article, Page 113, illustrates the system.

Making Plastic Parts On Punch Presses

Manufacturing engineers who attended ASTME's Semiannual Meeting in Toronto last month had an opportunity to learn of some interesting new developments. None, perhaps, is more dramatic than the advent of plastics that can be cold-formed on conventional metalworking dies in conventional presses. Francis M. Mallee, research engineer with The Budd Co., reported on experiments with polycarbonate resin sheet at the meeting. Those who could not attend the meeting can read a summary of Mallee's findings in his article, Page 116.

Making Cone Blanks

Parts made from cone blanks range from funnels and hoppers to jet engine sections. Figuring out how much metal to use to produce the blanks economically used to take a lot of engineering time. Engineer M. W. Loftus has developed formulas that are much more direct than many of those in common use. His formulas are presented in the Reference Sheet starting on Page 117 of this issue. Companies that adopt these formulas will find that they can save a great many engineering man hours.

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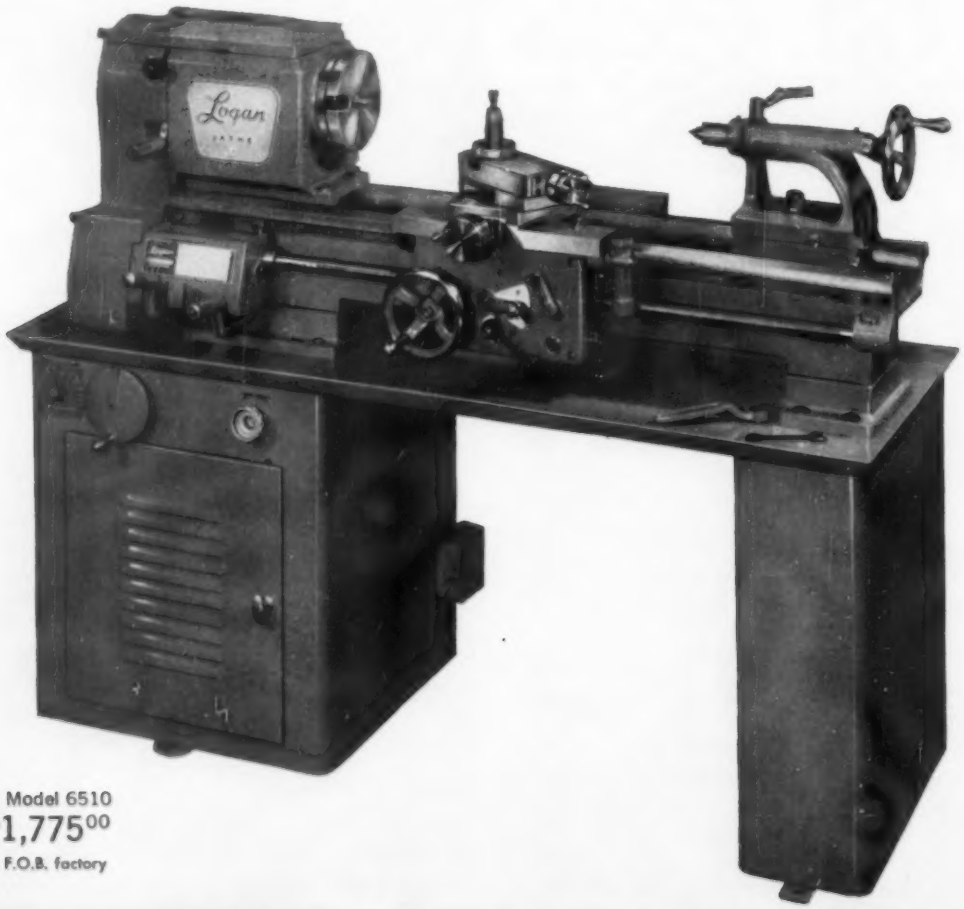
How is a lathe's dependability measured? One criterion is the lathe's productive life-span. And this life-span is largely determined by the lathe's quality of design and construction. The Logan lathe bed is an example. It withstands the heaviest bending and torsional stresses. A special alloy and thorough seasoning (before and between machining) insure a warp-free bed. Also, the two V-ways and flat ways are precision ground. You can depend on Logan's low operating cost, too. The 14″ swing lathes have variable speed drive (40 to 1400 RPM), and are instantly adjustable while work is turning—without shifting belts! You can also depend on the flexibility of Logan lathes. They have a 9″ swing over saddle, 14⅝″ swing over bed, and a 1 1/16″ collet capacity to permit a wide variety of operations. But, specifications tell the full story. So, write today for complete information.



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LOOKING AHEAD

By T. W. Black
Senior Associate Editor

Whole sections of a space vehicle might disappear during an extended space voyage if the wrong metal is used in its construction, according to Hughes Aircraft Co. scientists. In a super vacuum, many metals evaporate. Further, grease and other lubricants vaporize in a high vacuum and a machine that runs smoothly on earth would not function in space, since its bearings would dry up and seize.

Cold welding is another problem that will be faced by spacemen. In atmosphere, all materials are coated with layers of adsorbed gases and impurities. These would evaporate in space. With the protective layers gone, bare atom could contact bare atom and metals would become attached to each other as securely as a welded joint.

These phenomena point up the problems that must be solved before genuine space travel can be realized. Space presents a radically different environment from what man is accustomed to and even the most commonplace materials, practices and techniques often must be carefully tested to insure that they will not have completely unexpected results.

Hughes tests show that titanium, tungsten and platinum are among the best materials for spacecraft, since they do not evaporate appreciably in a vacuum. Use of low-vapor-pressure lubricants and solid-film lubricants, and constructing bearings of materials such as teflon, which requires no lubricant, are possible answers to space lubrication problems.

Polyurethane die blocks are replacing the female member of the conventional pair of steel dies used to stamp lithographed, plastic-coated, embossed and highly finished metal blanks, according to Standard Die Set Co. This plastic material has only about 2 to 3 percent compressibility yet it elongates as much as 600 percent. As the punch pushes the blank into the plastic block, the upward displacement of material applies force to the face of the blank at an angle of 70 to 90 degrees, pressing the blank uniformly against the die. This compensates automatically for any variation in the gage of the blank.

Polyurethane plastic foam is being used in rocket fins to replace the usual cast aluminum structures--a method developed by the Atomic Energy Commission. Polyurethane is poured and simultaneously bonded into the fin core, the clamped aluminum sides of which serve as a mold. Elimination of core machining and the need for external rivets and fasteners greatly reduces the cost of the fins, while increasing shear strength.

A new aluminum-filled epoxy material developed by The Boeing Co. and American-Marietta is being used to make low-cost tools for forming thermosetting plastics. The material is a dry powder, which is poured into a mold and liquefied by heat. Tolerances as close as 0.001 inch can be held. Tools of the new material are being used for production runs as well as prototype work.

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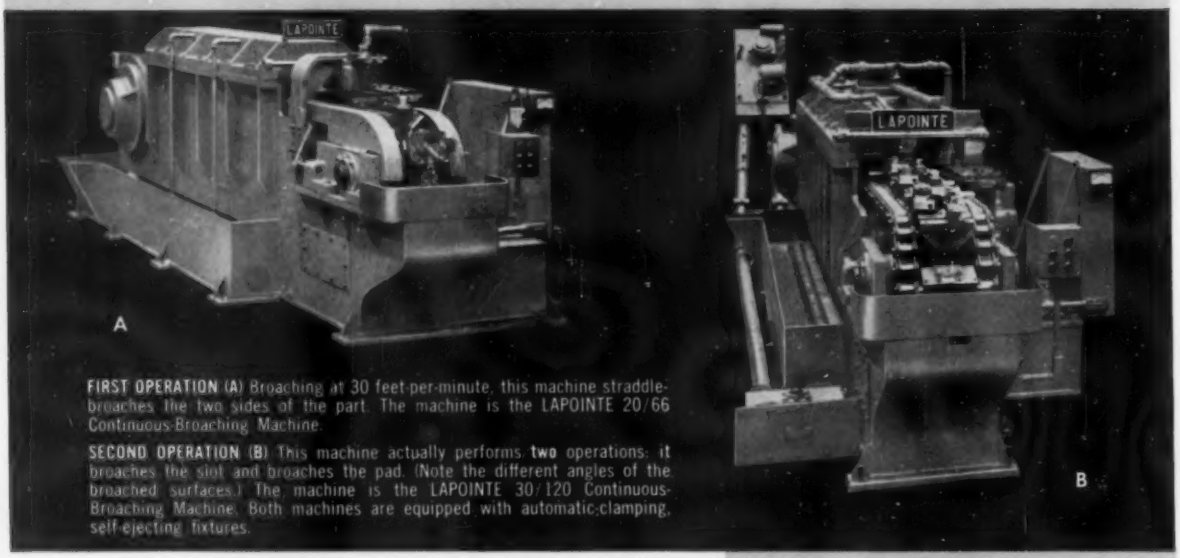

FIRST OPERATION (A) Broaching at 30 feet-per-minute, this machine straddle-broaches the two sides of the part. The machine is the LAPOINTE 20/66 Continuous-Broaching Machine.

SECOND OPERATION (B) This machine actually performs **two** operations: it broaches the slot and broaches the pad. (Note the different angles of the broached surfaces.) The machine is the LAPOINTE 30/120 Continuous-Broaching Machine. Both machines are equipped with automatic-clamping, self-ejecting fixtures.

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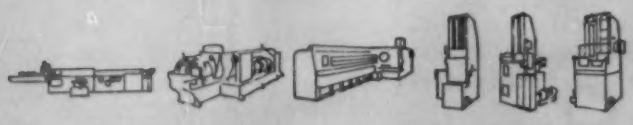

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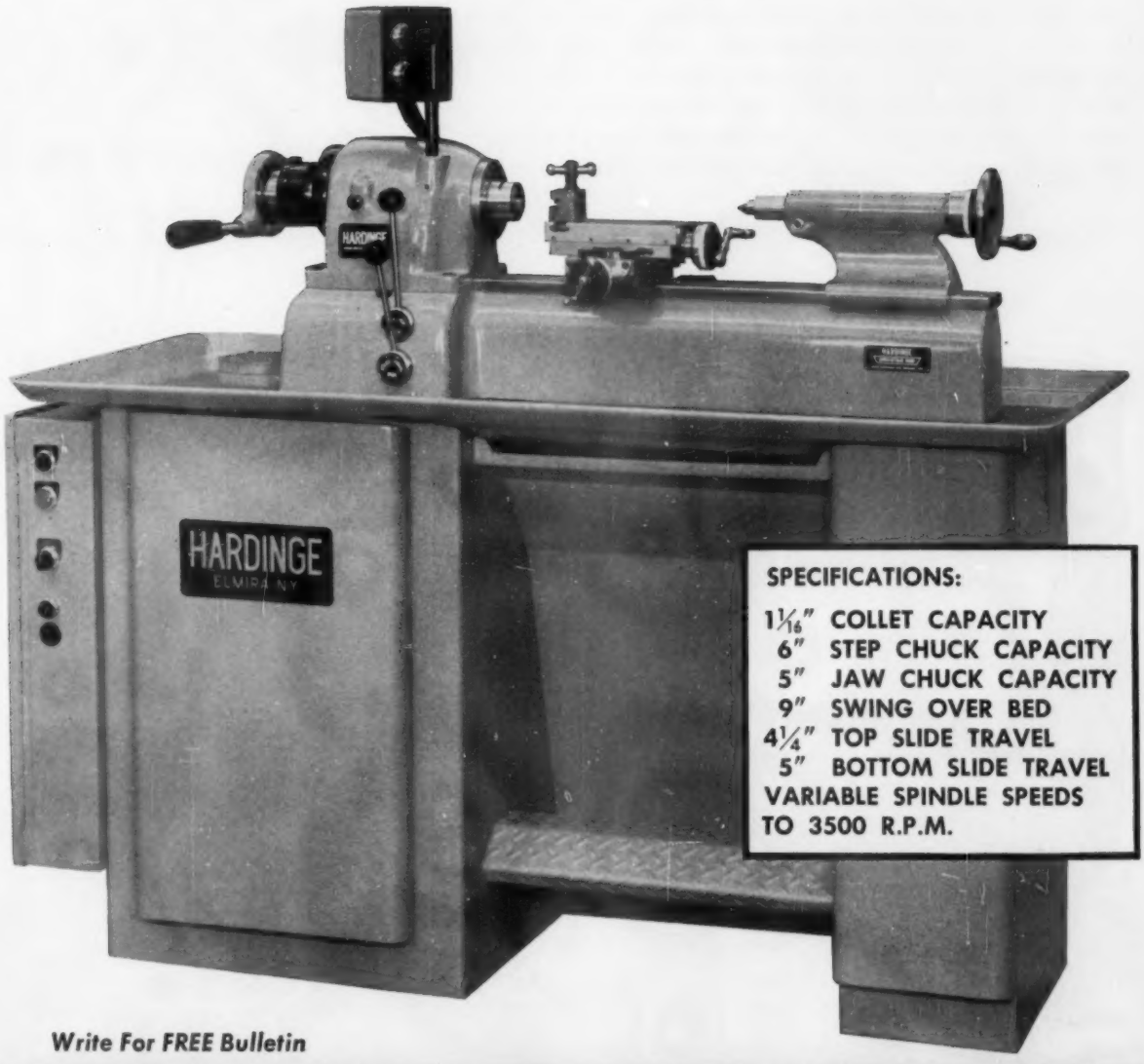

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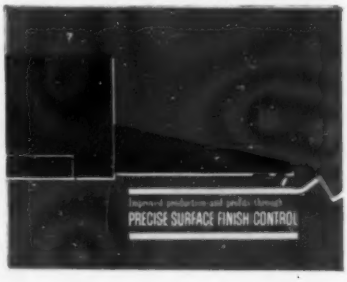

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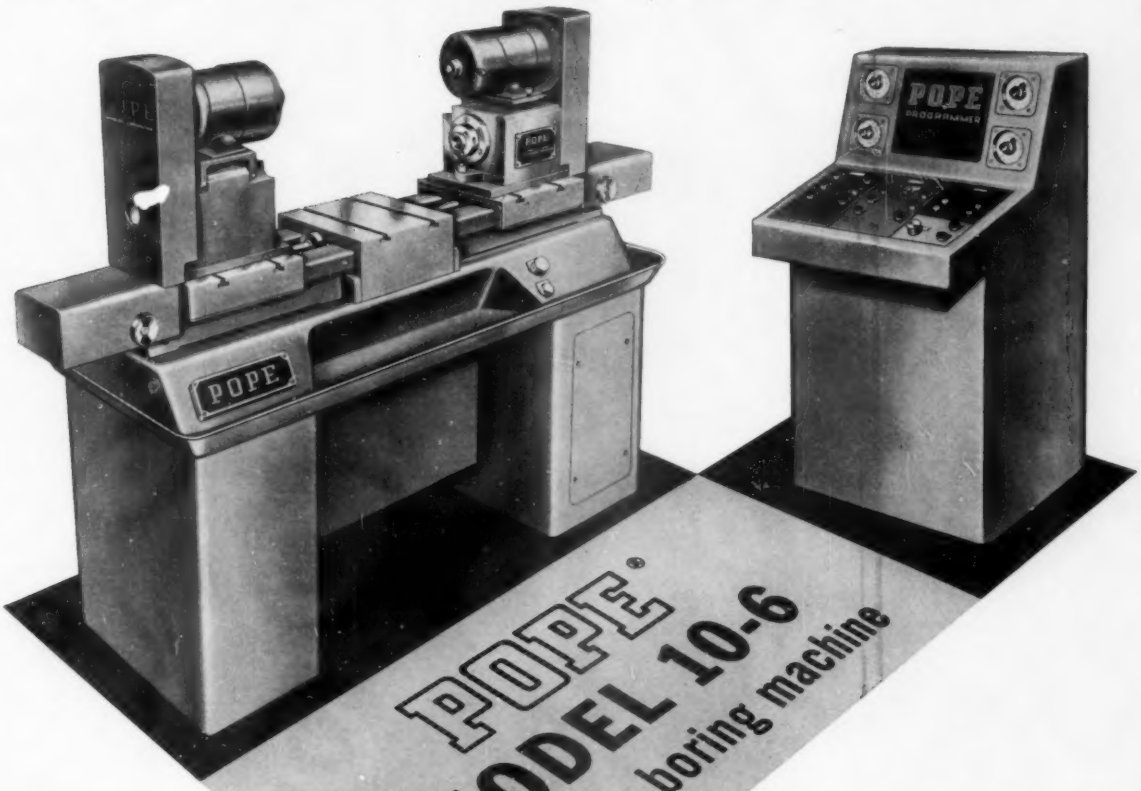

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- Maximum stroke, each head — 6"
- Standard center height — 5½" (variable)

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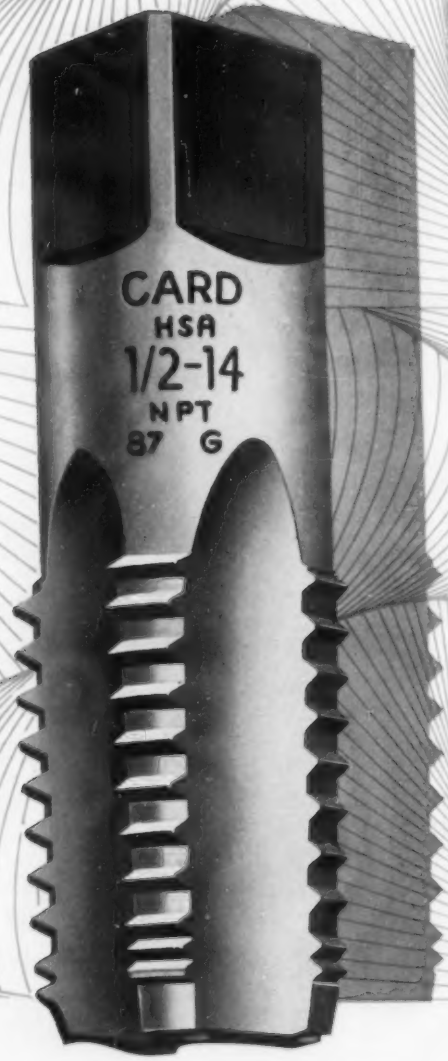

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GEOMETRIC PROGRESSION symbolizes the precise duplication you need in cutting tools. CARD makes sure you get this production advantage in actual form . . . through expert engineering that reproduces CARD tools exactly, plus helpful service from your CARD distributor and the CARD technical man, who are quickly available in the nation-wide CARD network. CARD DIVISION, Union Twist Drill Company, Athol, Massachusetts. CARD Warehouses: Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York, San Francisco.

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New—
CARMET'S 700 Series Cutting Grades and the fine art of making chips

Some people baby their carbide tools. They hold back a little on roughing cuts, because they've heard carbide is pretty brittle . . . and some of it is. Or they ease off on finishing cuts, because their tool may be too soft for long, fast passes . . . because it may wear or crater. And, some of it will.

But this is "paring-knife" machining, and it really isn't necessary. Not any more . . . not since Carmet introduced the 700 Series Steelcutting Grades. No paring knife made these chips . . . these were hogged out on a production basis by one of Carmet's new carbides . . . Grade CA-720.

The job: rough facing railroad axle forgings in an automatic tracer lathe—210 sfm—.076" feed—1¼" width of cut. The result: over 1,000 cubic inches of steel removed in 5½ minutes, floor to floor, with plenty of red hot chips like these. And, 35 axles per tool against 25 pieces for the best competitive carbide tool . . . a tool carrying a higher price tag.

Carmet's 700 Series have the edge wear and crater resistance, *and* the ability to endure shock and heat, to breeze through jobs like this. They're doing just that all over the country . . . right now! Next time you're setting up a mean, tool-buster of a cut, let the 700 Series make chips and money for you, just once. Your Carmet Distributor has the local stock and all the information. Call him, or write:
Carmet Division, Allegheny Ludlum Steel Corporation, Ferndale, Detroit 20, Michigan. Dept. TE-11.

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New FACET TOOTH™ Tungsten Carbide rotary files—up to 25 times more efficent than ordinary T. C. rotary files.

New BI-DEX™ Tungsten Carbide rotary files—eliminate "dead" areas for faster, better, more even metal removal.

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The new patented counterbore knurl provides a more acute angle of entry for deeper penetration and greater knurl contact — hence maximum vibrational holding power.

NOW! Vibrational holding power hits a new high!

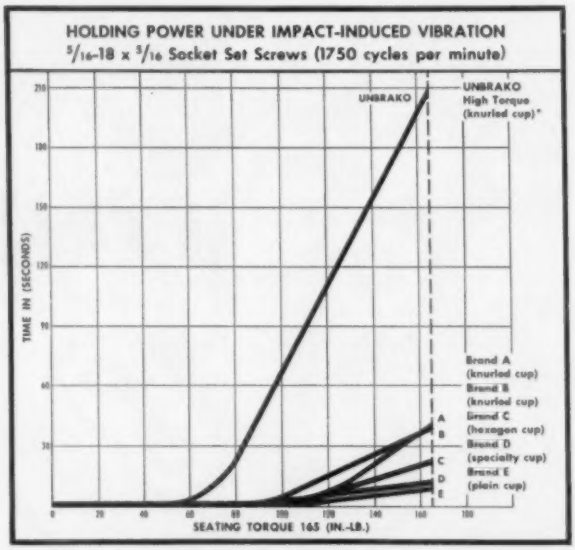
. . . which means that costly downtime hits a new low! For the new UNBRAKO set screw with patented* counterbore knurl won't crack in tightening and doesn't require continual retightening. Set screw failure becomes a thing of the past when you specify "the one that won't work loose."

The new UNBRAKO High Torque is two ways tighter than any other socket set screw. First, the new counterbore knurl produces deeper shaft penetration. This is precisely what you need and want in order to achieve positive locking action *before* . . . and unparalleled vibrational holding power *at* the recommended seating torque.

Second, UNBRAKO's seating torques are up to 40% higher than those of ordinary set screws, and the tighter a screw is wrenched the greater its holding power. Behind UNBRAKO's higher torques:

- Exclusive Hi-Life thread root that distributes stress concentration at critical area
- Fully formed threads with metal compressed into a closely knit grain structure
- Deeper sockets for maximum key engagement and wrenching power
- Precision heat-treated steel to eliminate brittleness or decarburization

As you can see from the graph, the new UNBRAKO offers vibrational holding power no other set screw can begin to achieve—*throughout the entire torquing range.*



The new UNBRAKO High Torque Set Screw—with counterbore knurl and Hi-Life threads—is available in sizes #4 through 1 in. Your authorized UNBRAKO distributor has a complete supply on hand *now*. Where shaft penetration is undesirable, specify UNBRAKO with Nylok.† For a copy of our new booklet on UNBRAKO High Torque Set Screws, write to Standard Pressed Steel Co., INDUSTRIAL FASTENER DIVISION, SPS, JENKINTOWN 37, PENNSYLVANIA.

*No. 2,992,669—patented July 18, 1961 †T.M. Reg. U.S. Pat. Off., The Nylok Corp.

SPS

where reliability replaces probability

The Horn of Plenty

The wheat is gathered, the harvest is in and the yield is bountiful. Traditionally at this time, Americans pause in gratitude to reflect upon the richness this land of ours has bestowed—in both material wealth and wealth of opportunity.

We at American are truly thankful for what we have attained—in 20 short years, from a small and little known company to the enviable position of the world's largest manufacturer of drill jig bushings, with 36,000 standard sizes in stock.

Only in America—the Land of Plenty—could this American success story happen—and only with the support of American business.

American gives thanks—humbly and sincerely—to the 200,000 loyal customers whose consistent purchases of our products have made the American dream come true. May we continue to serve you long and well.

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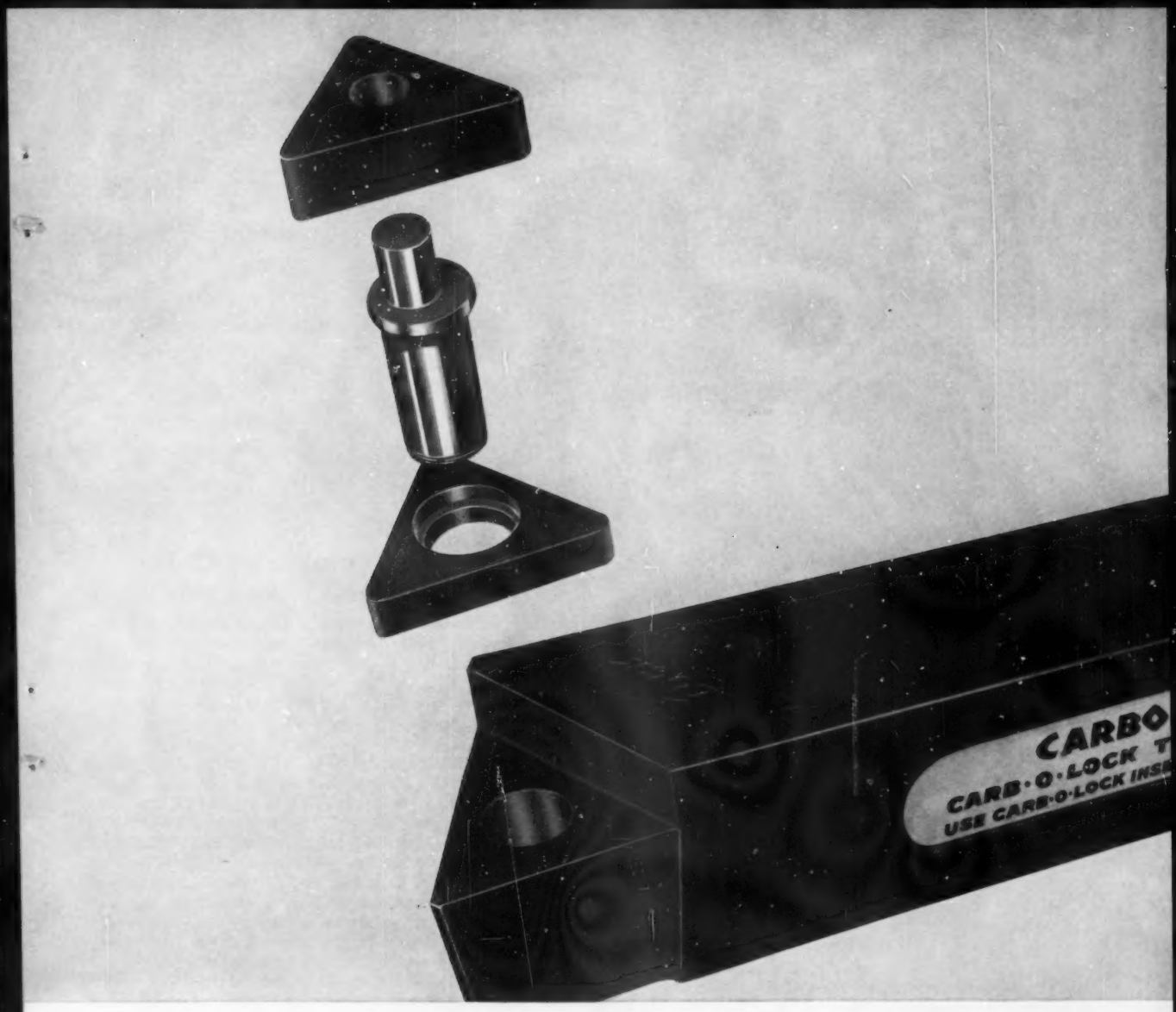
How to cut your disposable-tooling costs by 30 per cent at no sacrifice in quality or output. (Answer is on the next page.)



With the new Carb-O-Lock toolholder-insert combination. The single most important advance in the whole history of metal-cutting.

Save 30 per cent when you buy it. Save 40 per cent when you use it.

These are minimums. Users of the Carboloy Carb-O-Lock toolholder-insert combination have reported savings many times higher. Why?

Simple. The Carb-O-Lock design is simple. Using a cam-action locking principle, the Carb-O-Lock has just three parts (not including insert). Insert changing and indexing is a breeze; parts inventories can be held to absolute minimums. Streamlined design lets you bring the toolholder closer to your work. And less overhang means less vibration, less insert chipping and breaking.

Plus: the Carb-O-Lock gives you proven performance. A major diesel engine manufacturer discovered Carb-O-Lock allowed nearly triple the feed, eliminating two machines. A locomotive and car equipment company found Carb-O-Lock's simple, rugged design reduced time for tool changes and permitted maximum horsepower utilization.*

Carb-O-Lock inserts are available now in Grade 883 for machining cast iron, as well as many operations on the following materials: high-temperature alloys, type 300 stainless steel, brass, bronze.

So start your savings program today. Phone your Authorized Carboloy Distributor and order your Carb-O-Lock toolholder-insert combination. Save 30 per cent. And more.

Metallurgical Products Department of General Electric Company, 11101 E. 8 Mile Road, Detroit 32, Michigan.

**Case histories available on request*

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Production Pointers

from GISHOLT

More cost-cutting IDEAS—
to help you

COMBINED OPERATIONS CUT BALANCING COSTS AT WISCONSIN MOTORS CORPORATION

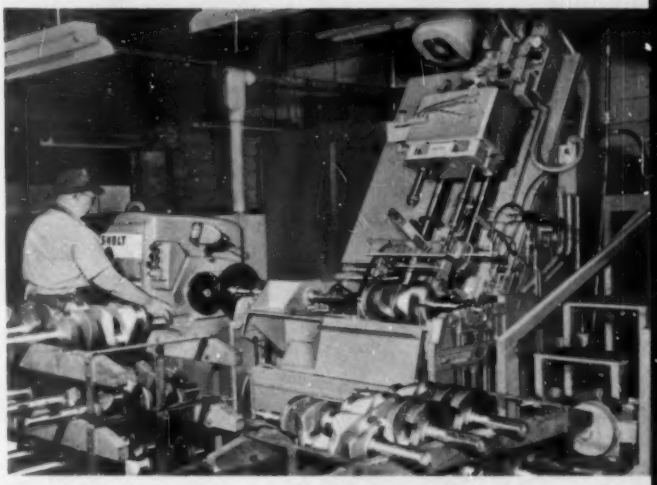
Gisholt Balancer replaces two machines . . . improves quality

How long would it take you to recover the cost of a new balancer if it permitted you to perform the entire operation . . . including correction and inspection, in one fast handling? This setup at Wisconsin Motors Corporation, Milwaukee, Wisc., will give you a good idea of the savings that can be yours . . . if you come to Gisholt.

Four different crankshafts are used in Wisconsin Motors Corporation's extensive line of heavy-duty air-cooled engines. Previously, unbalance was located and measured on two machines. Parts were removed for correction by grinding and returned to the balancers for inspection. Two operators were needed. Time was long . . . and accuracy suffered through multiple handlings and operator interpretation of unbalance indications. Now, *one* Gisholt MASTERLINE 2U Balancer with integral correction drilling equipment does the job.

Although quality is improved, operator effort is reduced to a minimum. One-half ounce inch tolerances are maintained by automatic controls that free the operator from all complicated decisions. Idle time is cut by positioning blocks, job-setup charts, pre-set drills, quick-change adapters, and interchangeable drill heads and depth control cams. One man can change-over to any size crank in two hours or less.

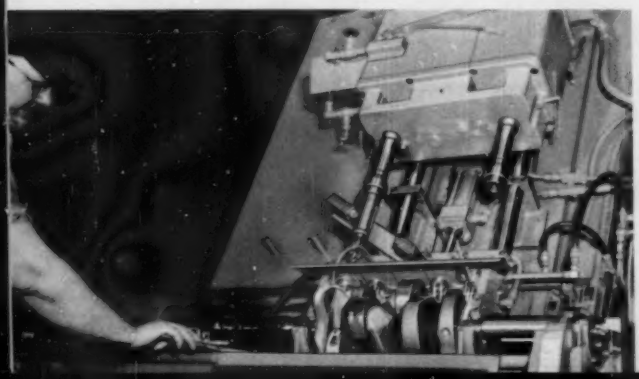
Work is held in a fixture which is locked while weights are attached to the pin bearings to simulate effects of connecting rods and pistons in the final assembly. During rotation the operator flips two levers to locate angle and measure amount of unbalance in both planes. He turns two handwheels to set angularly graduated protractors that provide a visual record of the angle for each plane. He turns separate dials to *electrically* register the amount of unbalance in each plane. Then the operator stops rotation and locks the fixture. He indexes the part to the recorded angle in the plane where the drill is already in place from the previous correction and presses a button. Because the amount of unbalance has been electrically registered, the drill feeds to the required depth in the counterweight with no further attention by the operator. The drill is removed and placed in the head for the other plane and the process is repeated. Then the fixture is unlocked and the work rotated for inspection.



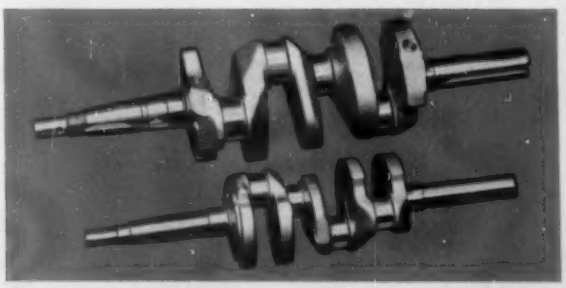
Crankshaft rotates at 300 rpm and is supported on half-bearings in fixture that locks for correction drilling operations. Integral correction drilling equipment improves accuracy, permits one operator to perform complete sequence in one handling.

One Gisholt 2U Balancer replaces two machines, eliminates multiple handling and improves quality by combining location, measurement, automatic correction and inspection. Ask your Gisholt Representative to show you how these principles can be applied to your parts.

For more information on Balancers, circle No. 768.



Operator indexes work to indicated angle and presses button for automatic correction in left plane by ⅛" drill starting at 3⅞" radius on crankshaft counterweight. Pre-set drill in quick-change holder is shifted easily from right to left plane. Entire drill head is replaced to minimize changeover time.

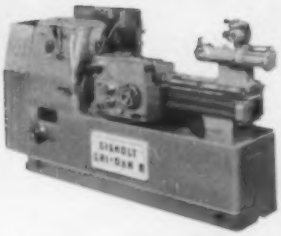


Top . . . largest part handled . . . weight 100 lbs. . . . produced in lots of 125. Previous production 4 per hour . . . now 8 per hour. Smallest part at bottom . . . weight 35 lbs. . . . produced in lots of 2,000. The 2U Balancer locates, measures, corrects and inspects at rate of 15 per hour.

OLD PROBLEMS SOLVED WITH NEW METHODS AT FORD TRACTOR & IMPLEMENT DIVISION

The next page and a half contains an article explaining how Ford Motor Company's Tractor and Implement Division, Birmingham, Michigan, has cut costs and improved product quality by trying two new approaches. Even more important is the fact that these goals were accomplished with *less* investment than would have been required had they purchased so-called "conventional" equipment to do this work.

BY AUTOMATICALLY MACHINING AND THREADING . . . Cri-Dan B offers low tool costs, peak accuracy and minimum threading times.

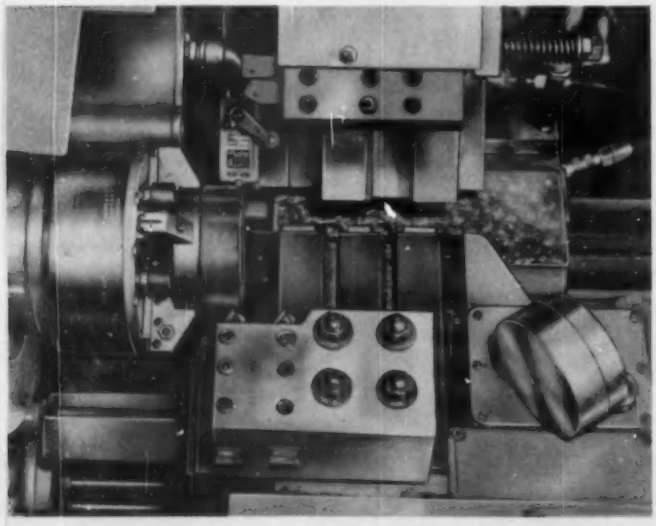


It's a fact. The new Cri-Dan Method can cut your threading costs by 30% to 80% with no compromise on quality. Here is how it is used in Ford Motor Company's Tractor and Implement Div., Birmingham, Michigan, to machine and thread SAE 1020 hydraulic accumulator cylinder ends.

Two sizes are handled. The same tools are used for both. After rough-machining, they are finished machined and threaded on a CRI-DAN B automatic threading lathe.

During the fast automatic cycle on the part shown, a 1⅛" long, 16-NS Class 3A thread is generated on the 4⅜₁₆" diameter end in 22 passes with the single-point carbide threading tool. A second tool lags the threading tool and removes the partial thread created at the start of the cut. This eliminates any weak section that might roll over and cause service problems. At the same time, two tools on a rear facing slide step-face the end with automatic tool relief at the end of the cut. Time . . . only 1.3 minutes f.t.f.

Simple Cri-Dan B setup saves time by combining facing and threading operations. A 1⅛" long, 16-NS Class 3A thread is generated by the single-point carbide threading tool in the front threading slide while the end is step-faced from the rear. Time . . . only 1.3 minutes f.t.f.



This is a typical Cri-Dan job. The tooling looks simple . . . and it is, because the *inexpensive* single-point carbide tool can be set up in 8 to 15 minutes to produce any kind of thread . . . automatically. Even in the toughest materials, threads are produced in a fraction of the time required by other methods. You can eliminate costly thread milling cutters, thread grinding wheels and special taps and dies. And you can combine standard machining or tracing with threading during the automatic cycle, for maximum efficiency.

Cri-Dan reduces time, tool costs, and work-handling. Combines machining and threading, offers finer finish (125 microinches rms) and repeat accuracy on Class 3A threading operations.

For more information on CRI-DAN, circle No. 769.

BY CUTTING FINISHING TIME ON FLAT SURFACES

Superfinish eliminates grinding saves 50% on variety of transmission parts

If you think Superfinish is used for cylindrical surfaces only, you may be missing out on important savings. *Gisholt* Superfinish can be used to cut time and tool costs on cylindrical, *flat*, *tapered* or *spherical* work. It can also eliminate tedious, more expensive methods.

For example, this setup at Ford Motor Company's Tractor and Implement Div., Birmingham, Michigan, has eliminated flat surface grinding and cut time in half on nine automatic transmission parts. Seven are Superfinished at both ends and two on one end for a total of 16 surfaces. Two, identically tooled MASTERLINE Model 81 Vertical Superfinishers handle all production.

Five of the parts are illustrated with some of the Superfinished surfaces indicated by arrows. The part in the air operated expanding mandrel fixture on the lower work spindle is a planetary gear carrier. During the automatic cycle, the Superfinish wheel descends to engage the flat surface and rotates in an opposite direction to the work spindle. A special variable speed drive arrangement keeps cross-hatch pattern to a minimum as the precision-faced surface is reduced from 120 to 10 microinches rms. Floor-to-floor time . . . only 30

continued on next page

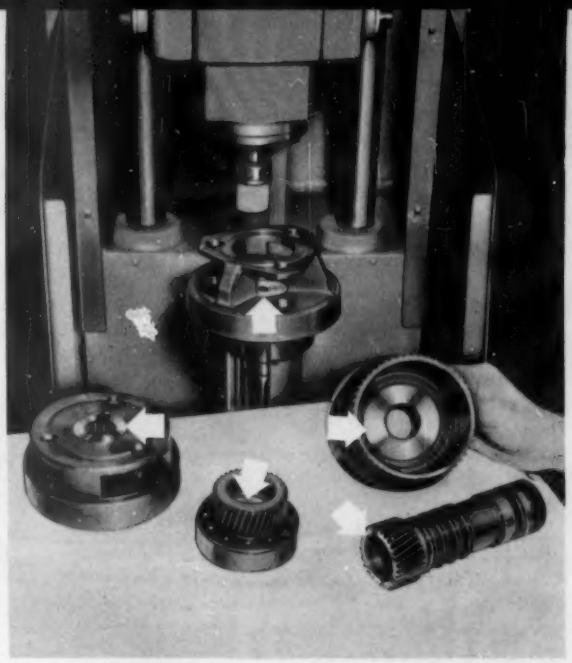
FORD STORY . . . CONTINUED

seconds. The other parts are handled in the same manner . . . to the same degree of finish . . . in the same amount of time.

With Superfinish you get any surface you require . . . whether it's 1 microinch rms or 80, piece-after-piece, automatically! Part geometry is improved, surface imperfections are eliminated, and jagged peaks are "scrubbed" away, giving up to 80% more bearing area. Smear metal is removed and base metal exposed so that specified hardness is maintained, to assure long service life.

Flat surface Superfinishing eliminates grinding, cuts finishing time in half on nine transmission parts. Offers further savings in initial cost, setup time and tooling.

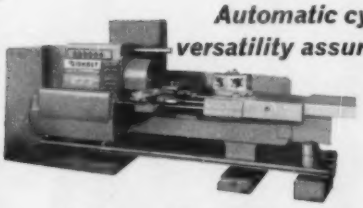
For more information on Superfinish, circle No. 770.



One of two identically tooled Gisholt MASTERLINE Model 81 Vertical Superfinishers used to handle 16 surfaces on nine different automatic transmission parts. On each part, the precision-faced flat surfaces of 120 microinches rms are reduced to 10 microinches rms in only 30 seconds, f.t.f.

NEW FASTERMATICS OFFER 15 MINUTE CYCLE SETUP

Automatic cycle plus turret lathe versatility assures maximum profits



This story illustrates how non-productive setup time has been reduced to a minimum, so you can get all the advantages of turret lathe practice with an automatic cycle on short or long run work.

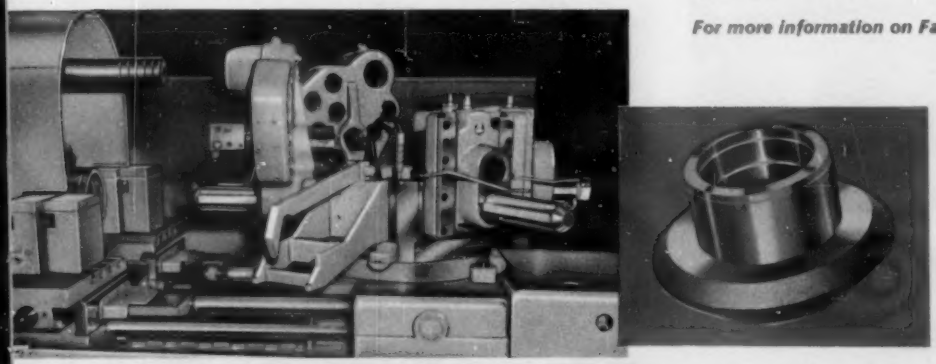
The machine shown is a new Gisholt MASTERLINE 3F Fastermatic with FeeDial Control. Fast, 15-minute setup makes the Fastermatic ideal for short run use. Individual dial controls select the *exact* feed for each station. The feed rate is shown in *inches per revolution* in windows at the top of each dial! Selector panel switches are "flicked" to pre-set speeds and machine functions for the six turret and two cross slide stations. Adjustment of traverse and feed trips, on a small hex drum at the headstock end completes the cycle setup.

Tool setting time is also reduced. The operator can take a test cut at *any* station, back up, mike the part, reset his tools and repeat the sequence *without indexing through the other five stations.*

The 3F FASTERMATIC is shown tooled for first operation work on 11⅝" diameter, 7" long steel bevel pinion forgings. A turret-mounted loader speeds locating and chucking. During the cycle, hex turret stations rough and finish turn two O.D. diameters, core-drill and finish three bore diameters. Rear and front cross slide tools operate with hex stations 1 and 2 respectively, to rough and finish machine two faces. Rigid machine design and a 40 hp motor permit rough turning using .015" feeds to remove up to ⅜" stock per side and core-drilling with up to ½" stock per side removed. Time is 13.3 minutes f.t.f.

The Fastermatic with FeeDial Control is available in three sizes. Fast 15-minute cycle setup, heavy metal removal capability and turret lathe flexibility guarantees top profits on your toughest parts.

For more information on Fastermatics, circle No. 771.



Tooling setup . . . utilizes turret-mounted loader (front) to speed locating and chucking of heavy part. Note how multiple tools are used with the automatic cycle to machine a maximum number of surfaces per chucking . . . to consistent quality at fixed rates. The operator is *free* during the automatic cycle to handle other machines. Inset shows workpiece and surfaces machined in only 13.3 minutes floor-to-floor.

TRACING SIMPLIFIES TOUGH CONTOURS AT WALTER KIDDE

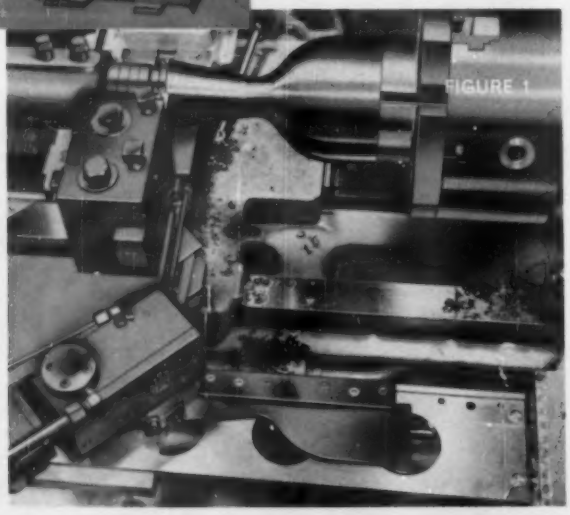
JETracers on ram and saddle type turret lathes save time and tool costs

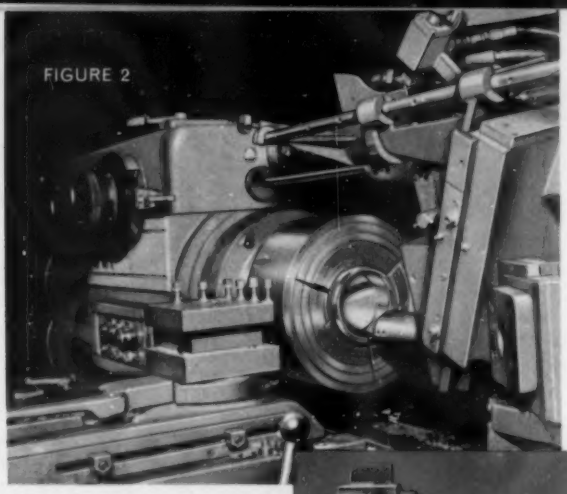
Walter Kidde & Company, Inc. of Belleville, N.J., has produced thousands of forged steel Jato nozzles each month—used to boost "take-off" power of heavily loaded aircraft. The way they solved the problems of machining tough internal and external contours may give you some ideas for your own operations.

The parts shown in these setups are 9⅛″ long. Diameters range from 2¾″ at the small end to 5⅜″ at the bell end. For first operation machining of the bore, a Gisholt 2L Saddle Type Turret Lathe is used. The setup is shown in Fig. 2 . . . the workpieces at left in Fig. 3. Work is held in a pot-type collet fixture. A turret-mounted JETracer slide tool removes from ⅛″ to ½″ per side at .011″ feed as it completes the 7″ long I.D. contour. Surface speeds range from 580 to 200 feet per minute. Time is only 3.48 minutes f.t.f.

A Gisholt Ram Type Turret Lathe is used for second operation machining of the O.D. contour. The setup is shown in Fig. 1 . . . the work pieces at right in Fig. 3. Work is held in the bore on an air chuck and located at the bell end against three special jaws that distribute chucking pressures to avoid possible distortion. A turret-mounted center provides additional support. A single-point carbide tool on the JETracer, mounted on the rear of the cross slide, is governed by the flat template as it removes from ¼″ to ½″ per side at .021″ feed, to complete the 11″ long O.D. contour. Again, surface speeds range from 200 to 580 feet per minute. Time is 1.53 minutes f.t.f.

View from rear of No. 5 Ram Type Turret Lathe shows flat template used to control single-point carbide tool on JETracer slide, mounted on rear of cross slide. Turret-mounted center supports as contoured O.D. is traced removing ¼″ to ½″ stock per side in 1.53 minutes f.t.f.





Gisholt 2L Saddle Type Turret Lathe with turret-mounted JETracer slide tool, used for first operation contour boring of Jato nozzles in 3.48 minutes f.t.f. JETracer stylus follows flat template held on carrier bar and has micrometer adjustment. Template and carrier bar locate from adjustable bracket attached to overhead pilot. Entire assembly can index with turret and does not restrict use of other tooling.

Even though you may not machine Jato nozzles, tracing can offer many cost-cutting advantages. These include fast setup and changeover, simplified machining and minimum requirements for operator skill. Costly form tools, multiple tool blocks and holders can be eliminated. Inspection time is reduced and there are fewer secondary operations.

First operation machining handled on Gisholt Saddle Type Turret Lathe with turret-mounted JETracer slide tool. Rough part at (a); machined part at (b). Second operation machining handled on Gisholt Ram Type Turret Lathe with JETracer mounted on rear of cross slide. Rough part at (c); machined part at (d).

Gisholt offers over 28 different JETracers for use with manual and automatic turret lathes and single-spindle automatics. Each operates at full capacity of the machine to which it is applied and does not limit machine functions or restrict use of standard tools.

For more information on JETracers, circle No. 772, on Rams, circle No. 773, on Saddles, circle No. 774.

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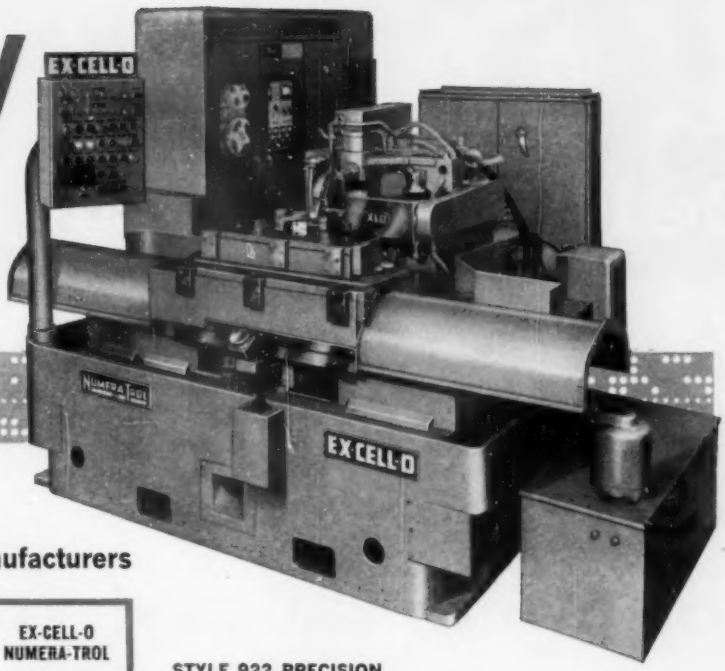


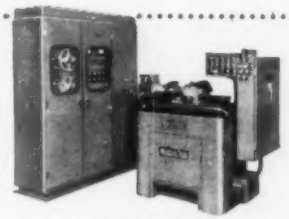
How Ex-Cell-O Numera-Trol Cuts Costs for Three Modern Manufacturers

Part: TEMPLETS	CONVENTIONAL METHODS	EX-CELL-O NUMERA-TROL
Lead time	128 hrs.	16 hrs.
Grinding per/piece	60 hrs.	6 hrs.
TIME SAVED	166 HOURS	

Part: FUEL CONTROL CAMS	CONVENTIONAL METHODS	EX-CELL-O NUMERA-TROL
Lead time	150 hrs.	40 hrs.
Machining per/piece	80 hrs.	7.5 hrs.
TIME SAVED	182.5 HOURS	

Part: STEAM TURBINE BUCKETS	CONVENTIONAL METHODS	EX-CELL-O NUMERA-TROL
Lead time	144 hrs.	24 hrs.
Machining per/piece	90 hrs.	12 hrs.
TIME SAVED	198 HOURS	

STYLE 922 PRECISION CONTOURING MACHINE
Slides are controllable to .000025". Grinding unit is interchangeable with boring and turning unit.



PRECISION CAM-MILLING MACHINE
Slashes lead time in producing drum-type cams.

PRECISION PROFILING MACHINE
Performs intricate and accurate milling and grinding of 3-dimensional forms.

Are you faced with tough prototypes or production parts that "can't" be produced economically? See your Ex-Cell-O Representative, or write direct for details on how you can apply Ex-Cell-O's Numera-Trol system of tape-controlled precision machine tools to do more jobs, faster and more accurately!

FREE—"A Guidebook to Numerically Controlled Machine Tools." Send for your copy today.

NUMERA-TROL (XLO)

60-44

EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

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Use Reader Service Card, CIRCLE 21

HUNT JACKSON HYQUIP Bellows

Bellows-Valvair

NOW...ONE SOURCE

for pneumatics • hydraulics and related electronics

These famous trade names — Bellows . . . Valvair . . . Hunt . . . Sinclair-Collins . . . Hyquip . . . Jackson — have many things in common. Two are outstanding. These companies are known to industry as leading suppliers of pneumatic, hydraulic and electronic products. And, they all are part of International Basic Economy Corporation (IBEC).

To make it easier for you to select the most economical combination of related products best suited to your needs . . . to provide you with application engineering recommendations for entire control systems . . . to render unmatched service . . . these sources of specialized products have been combined into one engineering, sales and service organization — Bellows-Valvair.

The Bellows-Valvair Pneumatics Division will engineer, sell and service all Bellows, Valvair and Hunt products involving the use of air. The Bellows-Valvair Hydraulics Division will engineer, sell and service Hunt, Sinclair-Collins and Hyquip hydraulic products, as well as Berry-Dowty gear pumps and motors. The Bellows-Valvair Electronics Division will engineer, sell and service all related electronic devices.

Consolidation of all sales and service under the name Bellows-Valvair combines the knowledge and experience of over 300 design, production and field engineers. The resources of this group are at your service, ready to aid you in the engineering and application of pneumatics, hydraulics and electronics, to solve your production problems.

Valvair SINCLAIR-COLLINS

New Bulletin FP-62 will give you more information on the divisional product groupings. For your copy, contact the field office near you (listed in the Yellow Pages and Thomas' Register, Volume IV), or write to Bellows-Valvair, Akron 9, Ohio, Dept. TE-1161.

1200-C

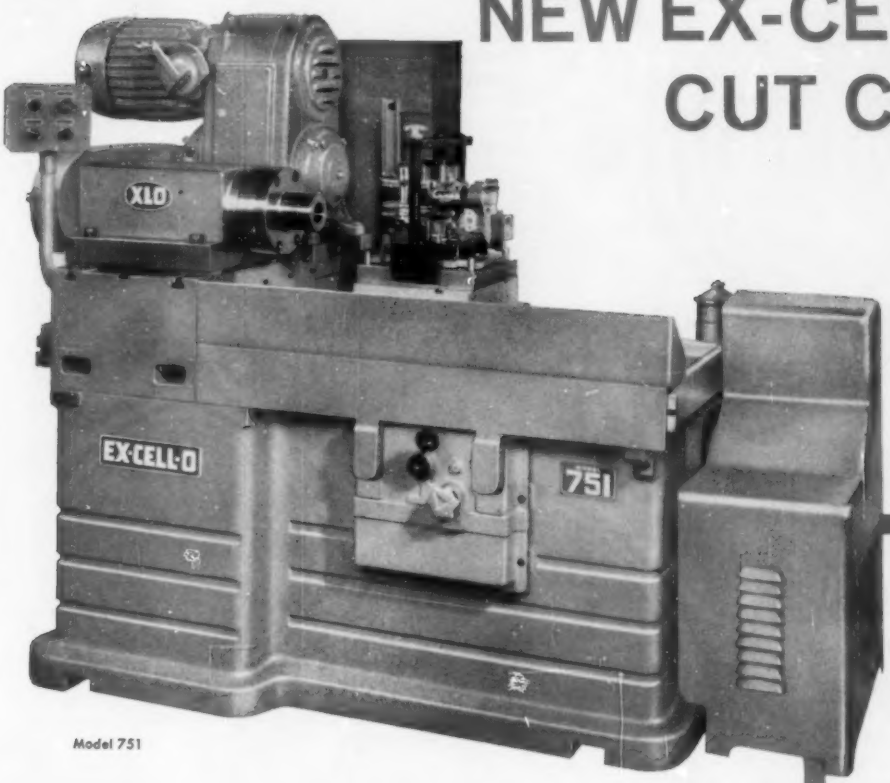
Bellows-Valvair

Division of IBEC AKRON 9, OHIO

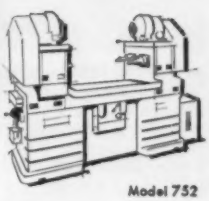
These names assure you the best in pneumatic, hydraulic and electronic components

BELLOWS * VALVAIR * SINCLAIR-COLLINS * HUNT * HYQUIP * JACKSON ELECTRONICS

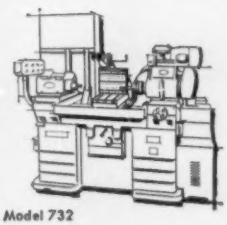
7 REASONS WHY THESE 4 NEW EX-CELL-OS CUT COSTS



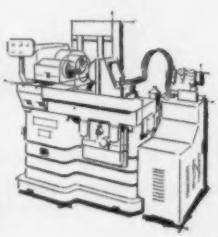
Model 751



Model 752



Model 732



Model 731

Designed and built for maximum dimensional stability under all operating conditions, these new hydraulically operated precision boring machines offer the ultimate in accurate repeatability.

Check these features for production efficiency . . .

- **Temperature controlled hydraulic panels**
- Extreme rigidity and stability in bases and tables
- Hydraulic and coolant system externally mounted
- Ex-Cell-O standard and tapered roller bearing spindles
- Designed for close-tolerance precision boring, turning, facing, counterboring, chamfering, grooving, recessing and trepanning operations.
- May be operated either manually or automatically.
- Engineered for simple installation into automated production lines.

Contact your Ex-Cell-O Representative or write direct for details.

61-87M

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PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

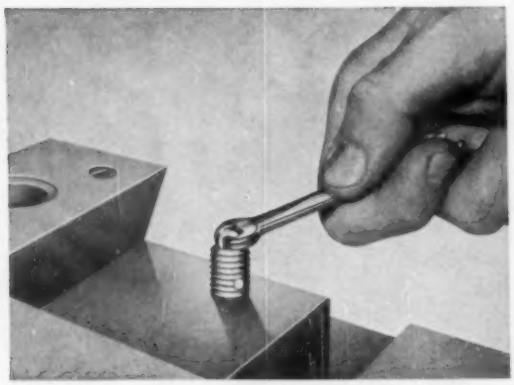
Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

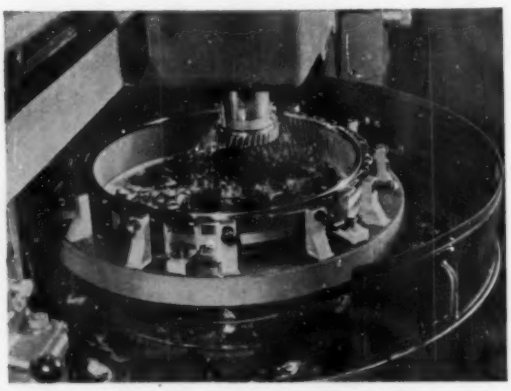
Practical Tooling Tips

No. 4 of a series

New uses are being found every day for Vlier Tooling Accessories. Perhaps the applications shown below will suggest ways you can profit by replacing costly, custom devices in jigs, dies and fixtures with precision, off-the-shelf Vlier products.



HEX NOSE SPEEDS INSTALLATION OF SPRING PLUNGERS—Vlier Hexnose Spring Plungers are easily installed with a simple end wrench. Eliminates hunting for special wrenches. Made to same exacting tolerances as Vlier Standard Spring Plungers. Available in many end pressures, diameters and lengths.



THIN-WALLED RING GEAR HELD SECURELY in fixture without distortion with 12 Vlier Torque Thumb Screws. Once pre-set end pressure is reached, knurled head spins freely, preventing overtightening. Checknut prevents backing off under vibration. Available in four types; various screw diameters and lengths.

SMALL, PRECISION, SPRING-LOADED BALLS provide controlled end pressures, won't bind from side thrusts. Sizes from 4-48 x 3/16" to 5/8-11 x 1". Various end pressures. Also available in all-stainless steel with Nylok.

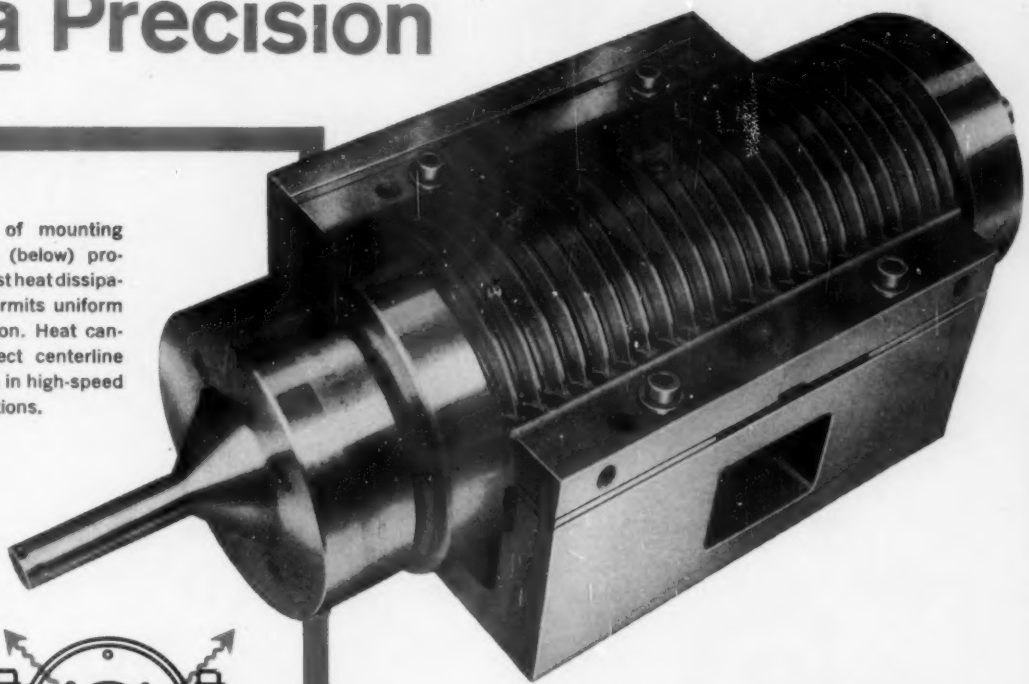
FREE IDEA BOOKLET—Illustrations in this 16-page booklet show how others have profited from the use of Vlier Tooling Accessories. Shows both the usual and unusual applications. May suggest ways *you* can save. Write for your copy today.

VLIER
Engineering Corporation

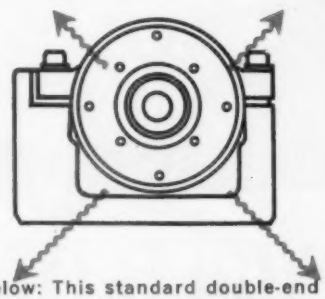
BW *A subsidiary of Barry Wright Corporation*

8900 Santa Monica Blvd. • Los Angeles 46, California

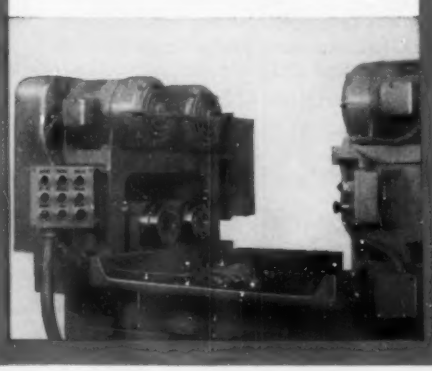
NEW Ex-Cell-O Spindles for Ultra Precision



Design of mounting bracket (below) provides fast heat dissipation, permits uniform expansion. Heat cannot affect centerline position in high-speed applications.



Below: This standard double-end Ex-Cell-O Precision Boring Machine provides a steady platform for the ultra-precision boring job described at right.



The special spindle shown above is one of 16 identical Ex-Cell-O Ultra Precision Boring Spindles recently developed for an extremely demanding boring operation.

Customer specifications called for a guaranteed maximum allowable .00003" on roundness, with a 10 RMS or better surface finish. The spindles Ex-Cell-O delivered have consistently held .00002" on roundness, with a 6 micro-inch surface finish (and the customer has ordered duplicates)!

Why do the new Ultra Precision Spindles and other standard and special Ex-Cell-O Boring and Grinding Spindles give consistently greater accuracy, finer finishes and longer, trouble-free life?

The answers are: Engineering and production experience (more than 40 years); exclusive design and construction (using famous Ex-Cell-O Spindle Bearings); and job-tailored availability (Ex-Cell-O offers the most comprehensive line of belt-driven, air-driven, motorized and high-frequency spindles available today).

Need fast delivery of Precision Spindles for original equipment or replacement use? Call your Ex-Cell-O Representative today, or contact Ex-Cell-O in Detroit.

60-85

EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

EX-CELL-O CORPORATION

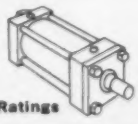
DETROIT 32, MICHIGAN

THIS...IS WHAT YOU BUY!

POWER — clean, dry, drip-free power at the business end of a Hannifin piston rod is the result of Hannifin extra quality, and at no extra cost. Bores are honed to 15 RMS or finer... piston rods are case hardened, plated and polished to 10 RMS or better. Cartridge gland, removable without dismantling cylinder, has exclusive Hannifin-developed "Lipseal®-Wiperseal" combination for a truly drip-free rod.

Modern straight thread leak-proof ports for easily positioned fittings are available at no extra cost on hydraulic cylinders.

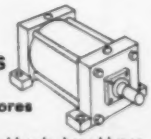
HYDRAULIC CYLINDERS



Two Pressure Ratings

2000 psi (3000 psi non shock), the famous heavy duty Hannifin Series "H" in 1½" to 12" bore.
1000 psi, Series "L", 1" to 8" bore, Hannifin quality in a lighter cylinder. Full compliance JIC Hydraulic Specs.

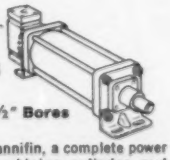
AIR CYLINDERS



1½" to 14" Bores

Series "A"—steel heads, honed brass body for corrosion resistance. Hardened and hard chrome plated piston rod. For all heavy duty air service. Easily modified for water service. Full compliance JIC Pneumatic Specs.

AIR MOTORS



1¾" to 4½" Bores

New from Hannifin, a complete power package combining cylinder and solenoid valve. Only one air line connection. Four mounting styles. Interchangeable mounting dimensions for most applications.

PARKER-HANNIFIN

HANNIFIN COMPANY DIVISION
519 South Wolf Road • Des Plaines, Illinois
PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS
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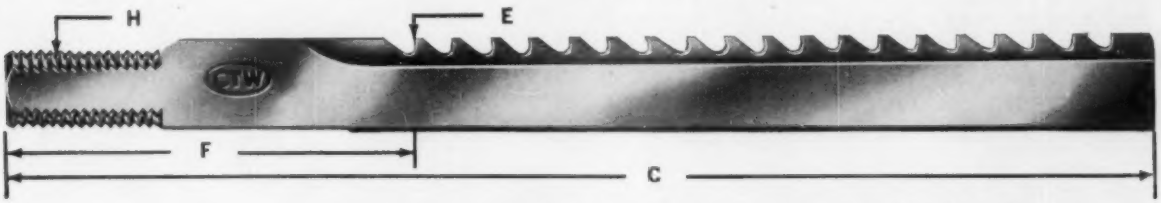
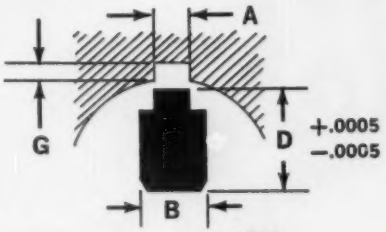
5128-PH

CTW Keyway Broaches in Stock NOW for Immediate Delivery!



Continental now stocks a popular range of standard keyway broaches to help you meet production schedules faster than ever, and to let you cut your tool inventory.

Just call your CTW Representative, or order by catalog number direct from Continental. The broaches you need are in stock now—ready for immediate delivery to your plant!



Sizes listed below are available for immediate delivery. See the CTW Catalog for other standard broaches. Special sizes quickly made to order. Send your print for a prompt quotation.

BROACHING INDUSTRY SERIES

Catalog Number	A Keyway Width			Min. Hole Size	Min.† Length Cut	Max. Length Cut	Width of Body B	Total Broach Length C	Height at Last Tooth D	Height at First Tooth E	Length of Shank F	Keyway Depth in Part G	No. of Cuts	Thread H
	Nom. Dim.	Decimal Dim.	Tolerance											
502	3/32	.0948	±.0002	7/16	½	1½	.1865	24	.367	.309	8¼	.058	1	5/16-18
504	⅛	.126	±.0002	½	½	1½	.249	30	.438	.364	9	.074	1	⅜-16
505	⅛	.126	±.0002	11/16	⅝	2½	.3115	36	.594	.520	10	.074	1	½-13
508	3/16	.1885	±.0002	11/16	⅝	2½	.374	36	.581	.476	10	.105	1	½-13
512	¼	.251	±.0002	11/16	⅝	2½	.374	36	.612	.476	10	.136	1	½-13
513	¼	.251	±.0002	1	11/16	4	.499	45	.877	.741	11 13/16	.136	1	⅝-11
514	¼	.251	±.0002	1 7/16	⅞	6	.624	51	1.250	1.114	13½	.136	1	¾-10
517	5/16	.314	±.0002	1	11/16	4	.499	45	.908	.741	11 13/16	.167	1	⅝-11
519	⅜	.3765	±.0002	1 1/16	11/16	4	.499	45	.938	.739	11 13/16	.199	1	⅝-11
520	⅜	.3765	±.0002	1 5/16	⅞	6	.499	54	1.189	.990	13½	.199	1	⅝-11
523	½	.5015	±.0002	1½	11/16	4	.624	48	1.312	1.051	12	.261	1	¾-10
524	½	.5015	±.0002	1½	1	8	.624	48	1.377	1.246	16½	.261	2	¾-10
ORIGINAL CTW SERIES														
CTW 7	3/16	.1885	±.0002	11/16	½	2½	.375	36	.581	.480	9	.101	1	½-13
CTW 10	¼	.251	±.0002	11/16	⅝	2½	.375	38	.612	.480	9	.132	1	½-13
CTW 11	¼	.251	±.0002	1	11/16	3½	.500	44	.877	.740	10	.137	1	⅝-11
CTW 14	5/16	.3135	±.0002	1	11/16	4	.500	46	.908	.740	10½	.168	1	⅝-11
CTW 17	⅜	.376	±.0002	1 1/16	11/16	4	.500	46	.938	.740	10½	.198	1	⅝-11
CTW 23	½	.501	±.0002	1½	11/16	3½	.625	46	1.422	1.160	10	.262	1	¾-11
ORIGINAL XLO SERIES														
XLO 3	3/16	.1885	±.0002	19/32	15/32	1¾	.250	28	.541	.438	8¼	.103	1	⅜-16
XLO 5	3/16	.1885	±.0002	⅝	⅝	2	.375	28	.541	.438	8½	.103	1	½-13

†MINIMUM LENGTH OF CUT RECOMMENDED TO PREVENT PART FROM DROPPING BETWEEN TEETH OF BROACH

61-33C

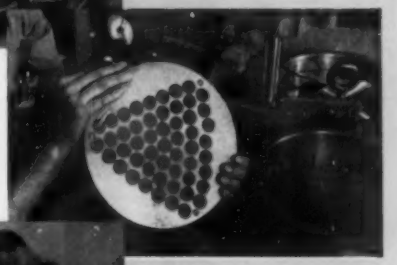
Continental CTW TOOL WORKS DIVISION OF EX-CELL-O CORPORATION DETROIT 32, MICHIGAN

What's new in LAPPING and POLISHING of SEMICONDUCTOR CRYSTALS

Texas Instruments Incorporated meets critical specifications in wafer production by lapping and polishing on these and other Lapmasters.

- Greater Parallelity Control
- Scratch-free Surfaces
- Improved Polishing Methods

Special fixture with adjustable diamond stop points guarantees lapping crystals to exact predetermined size and parallelity. It is only necessary to lap one face of the wafer flat prior to mounting.



Diamond fixtures are also available for Lapmaster Model 24 where production warrants it.

Free lapping provides excellent results where thickness and parallelity specifications do not exceed .0002" and are .008" or thicker. At Fansteel Metallurgical Corporation, Model 12 Lapmasters are used with special plates to achieve an extremely fine finish.

From the very beginning of the semiconductor industry, the Lapmaster has played an important part in achieving the parallelity, finish and critical size of wafers so necessary for reliable semiconductor performance. In fact, Lapmasters were used in the earliest laboratory experiments on semiconductors. Since then, Lapmaster engineers have continued to work hand-in-hand with semiconductor manufacturers in developing new lapping and polishing techniques to meet changing production and quality control requirements.

Over 100 semiconductor manufacturers now operate batteries of these machines —around the clock in many cases. Lapmasters are relied upon to consistently produce silicon or germanium wafers to size as thin as one mil and with parallelity tolerances to .000050".

Our wide experience in this and other fields can help you find the answers to your wafer lapping problems. Lapmaster Division engineers will work with you in developing the lapping and polishing technique that's exactly right for your particular specifications.

A few of the many new and improved techniques that work for others are shown here—contact us for more information. Request Bulletin L-450 for general information.

Lapmaster ...THE MACHINE THAT PUT PRECISION LAPPING ON A PRODUCTION BASIS

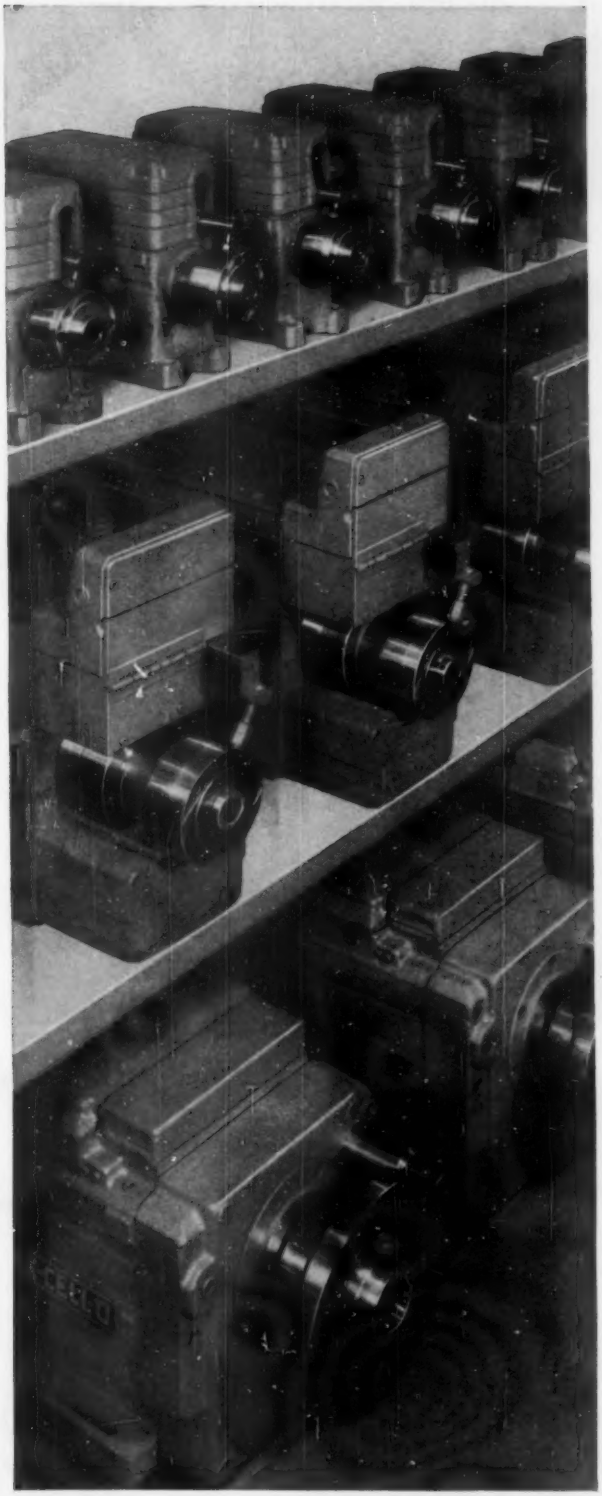
A product of

CRANE PACKING COMPANY

6469 Oakton St., Morton Grove, Ill. (Chicago Suburb)

In Canada: Crane Packing Company, Ltd., Hamilton, Ont.

In England: Payne Products International, Slough Bucks



NEED Power Units in a Hurry?

Ex-Cell-O gives you off-the-shelf delivery!

In stock for immediate delivery, Ex-Cell-O Hydraulic Power Units are available in four quill-type models offering a wide range of spindle speeds, horsepower, stroke and thrust.

Self-lubricating for low maintenance, and precision-built for long life, Ex-Cell-O Hydraulic Power Units, and our Canadian-built lead-screw type Tapping Unit, are designed for drilling, reaming, tapping, spotfacing and other single or multiple operations, and for heavy-duty boring and milling machine applications. Pre-set start, rapid approach and return, dwell, reverse and stop are fully automatic.

Your Ex-Cell-O Representative has complete specifications, or write direct for our catalog. The model you need is on the shelf now—ready for same-day shipment to your plant!

61-21MA

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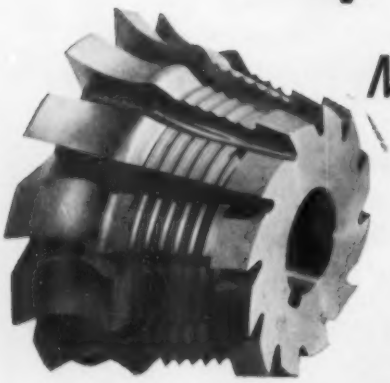
Machinery Division

EX-CELL-O CORPORATION
DETROIT 53, MICHIGAN

WHICH



MAKES THE BEST CUTTER?

Quality cutting tools reduce the cost of producing quality in your shop. The question is: How do you make sure about the quality of the design when you buy SPECIAL CUTTERS? The engineering available to you as a Barber-Colman

customer may be worth many times the price of the tools you buy. Our analysis of a milling operation often uncovers new ways of reducing costs through tool design—for example, economical combinations of cuts in a single operation. To provide you with more effective development man-hours per tool and maximize design flexibility, our engineers use electronic computers. From complex form data with design variations and modifications, the machines calculate specifications accurately and fast. Early consultation with our field or factory specialists can make these facilities and services available in the workpiece design stage. Perhaps we can make a cutter to produce a form you want but may think impractical. In addition to optimum cutter design, Barber-Colman offers proprietary innovations in cutting tool manufacture—in high-speed steel and carbide metallurgy and manufacturing technique. Prototype tool development, tooling, manufacturing, and inspection are done on specialized equipment not duplicated anywhere. Start by asking for a complete evaluation of your milling jobs by a Barber-Colman cutting tool specialist—a practical man who has come up through our

DESIGN

engineering department and knows how to solve your problems.

BARBER COLMAN

1112 LOOMIS STREET, ROCKFORD, ILL.

BARBER-COLMAN COMPANY

New

WESSONITE®

Cast Alloy Tools and Blanks

Wessonite bridges the gap between maximum speeds permissible with high speed steel and minimum speeds practical with carbides. Wessonite "H" is for general purpose machining of both ferrous and non-ferrous metals. Wessonite "HX" is for use where there is a minimum of shock or impact. Cutting speeds range from 100 to 190 sfpm for cast iron, from 50 to 300 sfpm for steels, and up to 1250 sfpm for aluminum.

To Make it Easier to Decide . . .

These Wesson booklets analyze all the factors involved in selecting the best type of tool for boring, for turning, for milling. Your Wesson field engineer has copies of all of them. Let us know which one you want.

WHICH IS BEST FOR TURNING... THROW-AWAYS,

How to get an

Ask Wesson . . . the answer will be unprejudiced because we make all *three* types. We can readily answer the question of which, where, when, why and how based on thousands of jobs successfully tooled with all three types of carbide tools.

Your local Wesson field engineer has immediate access to this accumulated experience plus his own extensive

WESSON

WESSON CORPORATION 1220 WOODWARD HEIGHTS BLVD., FERNDALE 20, MICH.

PLANTS IN: LEXINGTON, KENTUCKY • FERNDALE AND BRIGHTON, MICHIGAN

TURNING

On this operation—machining starter ring-gears—throw-aways are best. This TDR Multicut holder with Wessonmetal grade WM inserts is only one of several tooling recommendations made after a careful in-plant analysis. The company had previously used HSS and brazed tools. With tooling proposed by Wesson, production on this part jumped 40 to 45 percent!

ON-END or BRAZED ?

unbiased answer

training and experience in the carbide cutting tool field. He will be glad to make a complete in-plant study of your operations (no obligation of course) and recommend the best and most economical tooling.

Give him a call now . . . ask him about "guaranteed performance" and how you can get results like those shown here.

TURNING

On the same part, throw-aways also work best for gang-turning the OD of 21 gears at one time. The square inserts can be indexed eight times, give a total of 800 pcs. per insert. Results like this are what contributed to an over-all 40% production increase.

EXAMPLE: Schrader Square-end Cylinders not only have quality built into every part, but feature many extras. For instance, the unique cartridge-type bronze bearing assembly (A) is easily removed by releasing just one retaining ring—no need to dismantle the entire cylinder for bearing maintenance. Special "step" design cylinder seal (B) assures perfect alignment and positive seal without danger of gasket damage. Below surface cushion adjusting screws (C) are protected from damage but fully accessible. They lock to eliminate loosening due to vibration.

Interchangeable with all JIC cylinders, Schrader also provides a variety of mountings. Special bushings are available for bone-dry piston rod in hydraulic operation.

ANOTHER EXAMPLE: Schrader's new direct action Hydraulic Gauges without mechanical linkage (A) eliminate fatigue failure of internal parts. They can withstand 100% overload without damage to accuracy, and are triple-damped (B) to eliminate indicator oscillation from pump pulses, surges, or shock that would damage other types. Can be maintained and calibrated easily in the field. PSI pressure ranges 0-500, -1500, -3000, and -5000.

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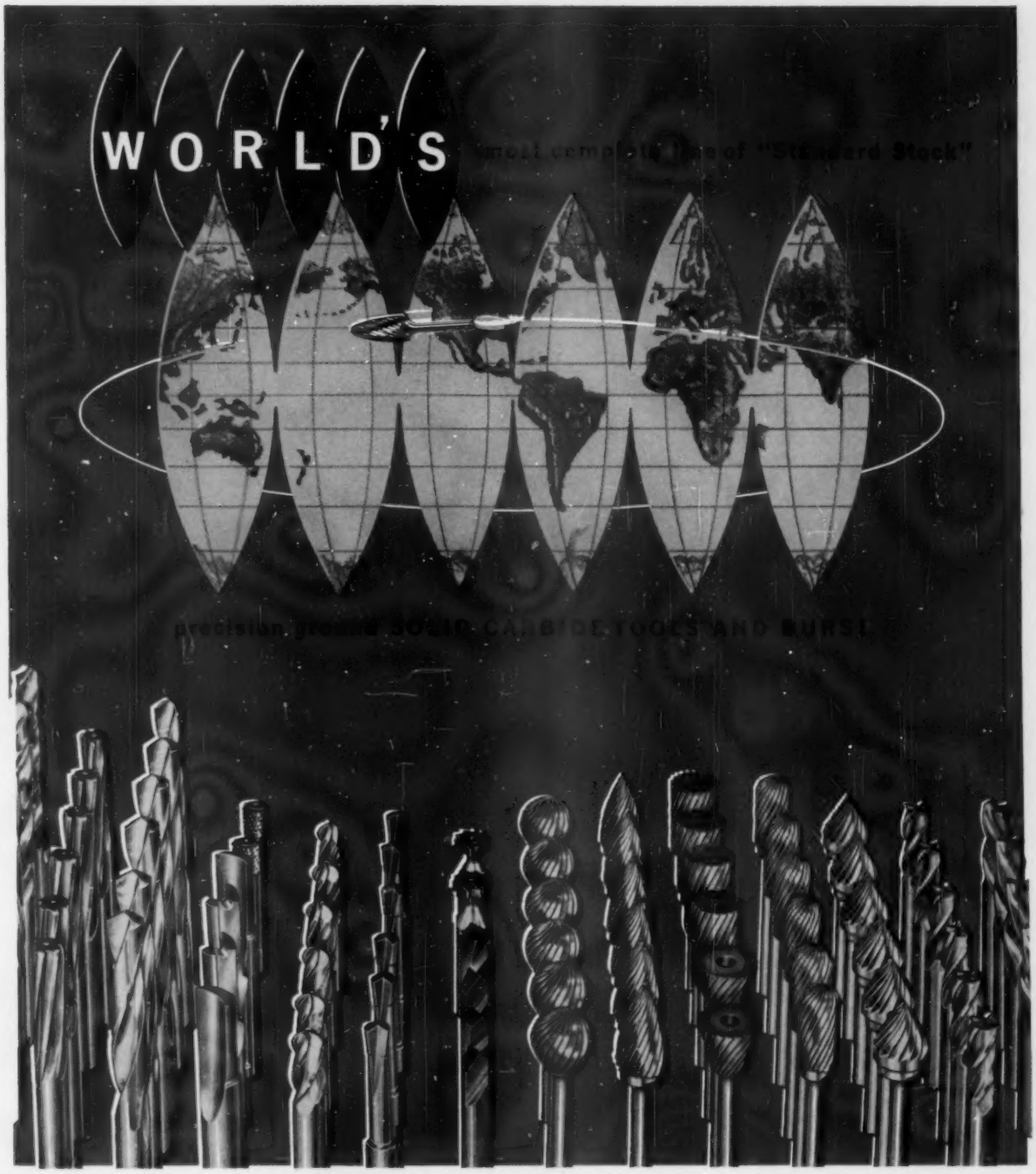

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ATRAX SHOP TESTED TOOLS FOR OUTSTANDING PRODUCTION PERFORMANCE

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Atrax distributors extend speedy off-the-shelf tooling service throughout the free world!

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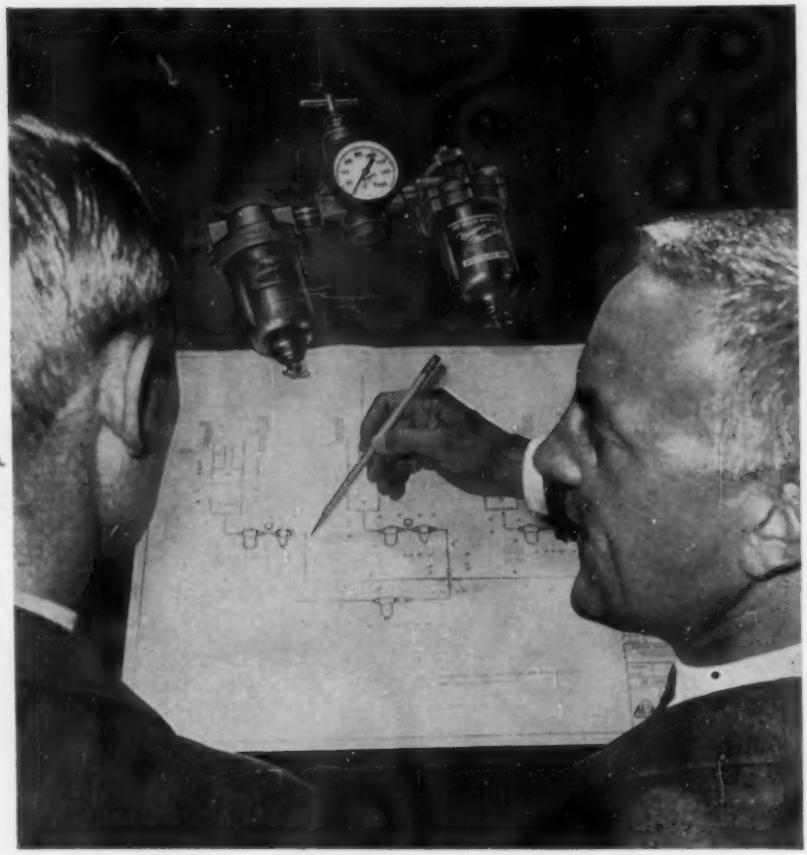

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They will be glad to give you expert technical information and assistance in any phase of fluid power: filtration . . . valving . . . lubrication . . . regulation . . . using fluid power for automatic control. They will counsel with you as to the best means of adapting pneumatic controls to a machine or machine mechanism.

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For complete technical information about Norgren Pneumatic Products—Pressure Regulators, Compressed-Air-Line Filters, Oil-Fog and Micro-Fog Lubricators, Control Valves—ask your Norgren representative (listed at left) for catalog N. 1000 . . . or write factory.

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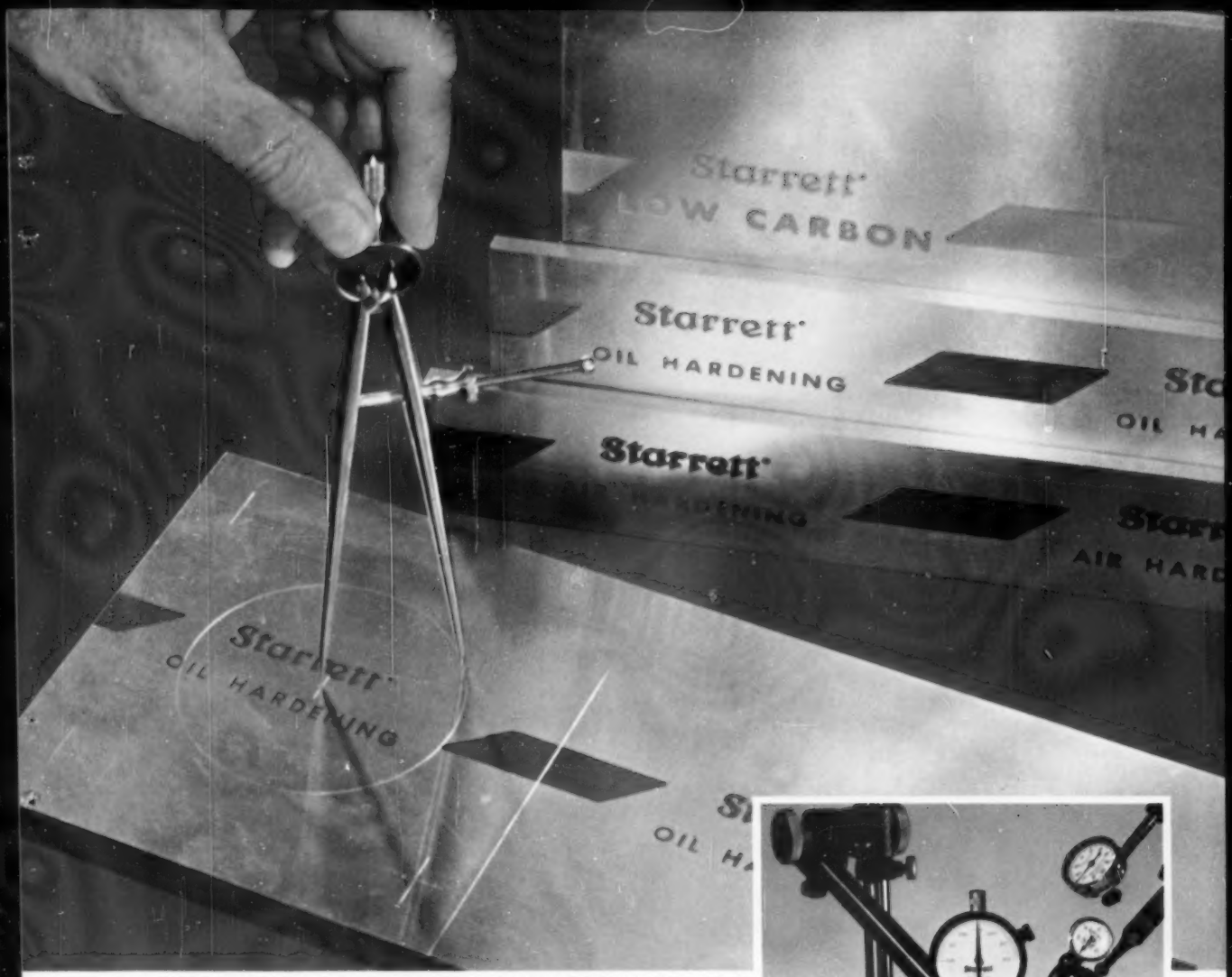

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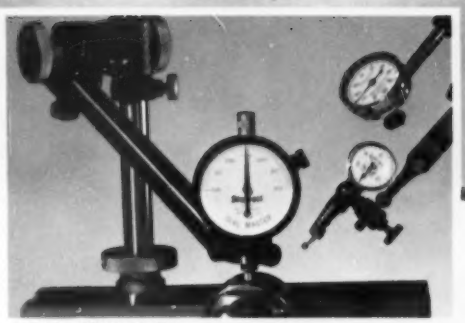

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World's Greatest Toolmakers

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PRECISION TOOLS.

NIKON OPTICAL COMPARATOR

new model 3A offers unusual screen brightness and image resolution – features zoom-condenser system

The unusual image brightness, definition and accuracy achieved in the new model 3A—to the very edge of the screen—is a credit to the quality and design of its optical system.

The new Nikon model 3A permits surface as well as contour inspection—independently or simultaneously. And controls are provided for adjusting the intensity of each of the illuminators.

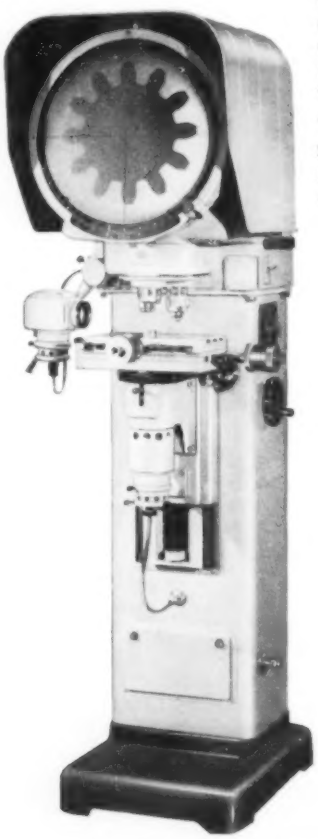
The surface illuminator may be used obliquely to emphasize surface texture. Or, for greater measurement accuracy, the surface illuminator may be used in conjunction with lens-mounted, half-reflecting 45° angle mirrors to provide shadowless light on the optical axis. Contour illuminator employs a special zoom condenser matching system. Convenient control simplifies adjustment for optimum illumination at each magnification.

Model 3A is normally supplied with a choice of one or more standard lenses in magnifications ranging from 10x to 100x. Other magnifications are also available on special order. A 3-lens turret supplied as standard equipment, facilitates instant changes. Focusing is smooth and effortless. Utilizes leadscrew drive with scraped ways and adjustable gibs.

The model 3A is equipped with a sliding hood which may be drawn out to shade the screen, or can be retracted to permit ready access to chart or screen surface. The overall diameter of the screen glass is 14½", designed for use with standard charts.

The new Nikon 3A accepts a wide variety of micrometer stages, holding fixtures, protractor screens, charts, photo attachments, and other accessories. For details write to Dept. TE-11.

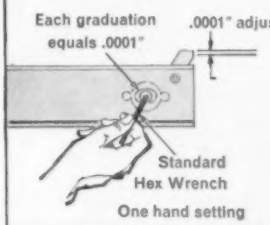
features new 14" screen



NIKON INCORPORATED Instrument Division 111 Fifth Avenue New York 3, N. Y.

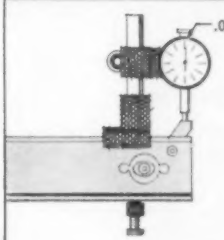
HOW TO IMPROVE MACHINING ACCURACY AND REDUCE TOOLSETTING TIME

DAVIS "SUPER-MIKE" TOOLS



TO SET

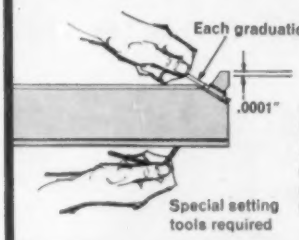
Operator or toolsetter simply adjusts the cutter the desired amount as indicated on the tool's direct-reading micrometer dial screw. The micrometer is accurate to .0001". Cutter lock screw remains locked throughout setting operation.



READY TO CUT

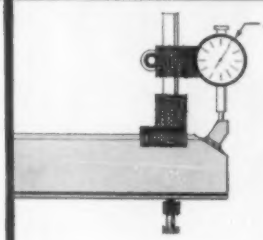
Because the lock screw is not disturbed during cutter setting, backlash or "growth" due to clamping is eliminated. An indicator check shows cutter set out accurately to .0001". Cutter is now ready for machining operation.

OTHER MICROMETER-ADJUSTABLE TOOLS



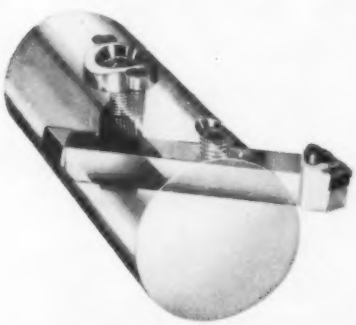
TO SET

Operator or toolsetter must first loosen cutter locking screw, then move the cutter out to desired position. Setting accuracies greater than .001" graduation on micrometer dial require use of special setting gage.



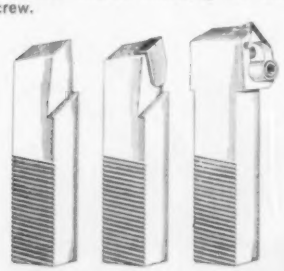
LOCK, RECHECK RESET

After cutter is set, it must be clamped by tightening down loosened lock screw. During clamping, backlash can result, requiring rechecking. Where extreme accuracies are required, setting, checking, and resetting process may have to be repeated several times.



HOW IT WORKS

Serrations on one side of the cutter engage with matching serrations on the expanding plunger. The plunger is threaded to the micrometer adjusting screw, moving up and down as the screw is turned to move the cutter in or out. High leverage makes it possible to adjust the cutter without loosening the lock screw.



These three cutters are completely interchangeable on any "Super-Mike" unit.

DAVIS "SUPER-MIKE" BORING TOOLS are unequaled among single-point tools for precision adjustment. The comparison above shows you why.

Whether you preset micrometer-adjustable tools in the toolroom or on the machine, you can save toolsetting time and improve machining accuracy with Davis "Super-Mike" boring tools.

"Super-Mike" cutters are adjusted easily and quickly to accuracies of .0001" on the machine or off using only a hex wrench and the cutter's direct-reading micrometer dial screw.

Extreme setting accuracy is assured by a special Davis design feature that enables the lock screw to remain in the locked position throughout the setting operation — thereby eliminating backlash after adjustment. A wide range of adjustment and close spacing in the bar make "Super-Mike" tooling ideal for a wide range of combined or successive operations.

"Super-Mike" cutters have a square body that fits directly into the bar. There are no adjusting sleeves around the tool to increase the size of the slot and weaken the bar. Square design also simplifies grinding. Like lathe tools, they need no special fixtures or holding devices. SHSS, TCT, or throwaway insert flycutters are standard with "Super-Mike" tooling. Interchangeability of all cutters in the same bar is assured by precision grinding of the adjustment screw and the serrations on the adjusting wedges and flycutters *after hardening*.

Standard "Super-Mike" flycutter tools are available for machining holes from 1¼" to 9". These tools are included in Davis "Super-Mike" stub boring tool sets, which also contain continuous-feed heads, boring bars, adapter sleeves, and the most commonly used setup accessories.

For complete information on Davis "Super-Mike" micrometer-adjustable flycutter tooling, write or telephone your nearest Davis distributor, or write for catalog D-520-A.

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GIDDINGS & LEWIS MACHINE TOOL COMPANY
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475 South Seymour, Fond du Lac, Wisconsin

Boring bars • block tooling • micrometer-adjustable flycutter boring tools • stub boring tool sets • boring heads • drilling and tapping heads • preset tooling for VTL's and VBM's • arbors and sleeves • adjustable drawkeys • setup accessories

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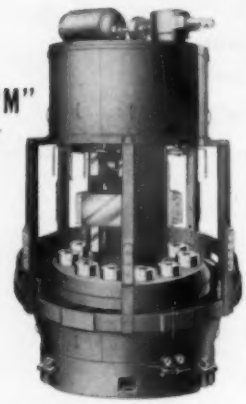
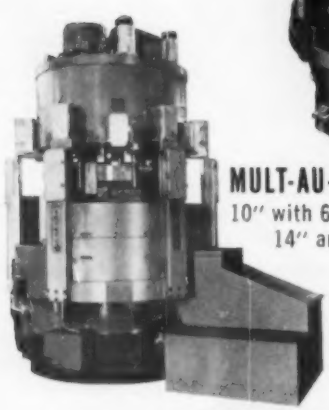


MULT-AU-MATIC, Type "M"
Available with 6, 8, or 12 spindles.



MULT-AU-MATIC, Type "L"
10" with 6, 8, 12, or 16 spindles, 14" and 18" with 6 or 8 spindles.

Before you buy, investigate the many outstanding features and advantages offered by modern Bullard Machine Tools.

Day-in and day-out – they are proving their ability to produce more in less time – thereby reducing the cost per piece.

For the complete cost-saving story, call your Bullard Sales Office or write

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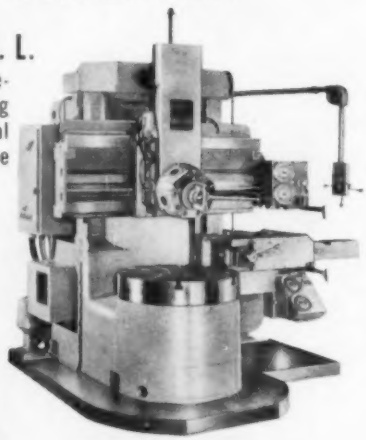
26" to 86" in 10" increments. Discrete positioning or contouring numerical control system can be applied.



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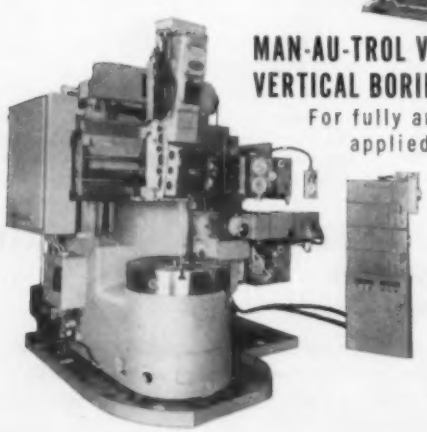

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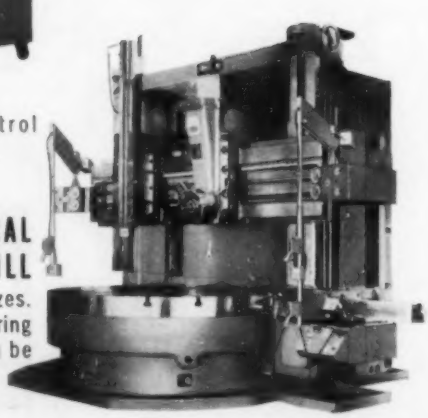

ACCURACY AND GRIP...

● Precisely the point...

When you buy new tools or rebuild old ones

START UP FRONT

- Precisely the point where the tool does its work.
- Precisely the point where profits are made and lost.
- Precisely the point where the accuracy and grip of Jacobs Chucks reduce tool breakage, downtime and rejects.

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INDUSTRIAL DISTRIBUTORS SERVING INDUSTRY ECONOMICALLY THE HAND OF PRODUCTION

THE JACOBS MANUFACTURING COMPANY,
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An important cost ratio . . .
and how to improve it

Wheel life to wheel output! With that ratio right, you save machine and operator time . . . cut rejects. And that's where Simonds can help you. How? With grinding wheels that head into the work with a bite that keeps biting . . . wheels with speed and stamina to make fast, efficient work of the toughest, hardest metals . . . wheels that save set-up time by often eliminating the need for wheel change when switching operations . . . wheels your Simonds distributor can supply in specifications that give you that essential, cost-cutting ratio between performance and production. Send for illustrated catalog now.

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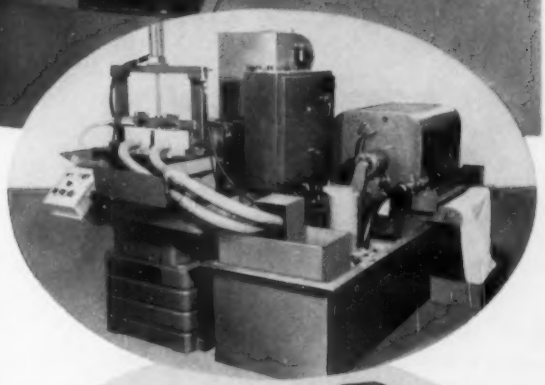
★SAVE EQUIPMENT DOLLARS
★IMPROVE WORK QUALITY
★SAVE PRODUCTION TIME



Star's master machinists will rebuild your present machine, (or one from our stock), equip it with high-efficiency Starbore tooling, and you will have the finest hole finishing equipment available. You get unexcelled, one operation precision hole finishing and a new machinery guarantee at a fraction of new equipment cost.

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Starbore TOOLING GIVES YOU

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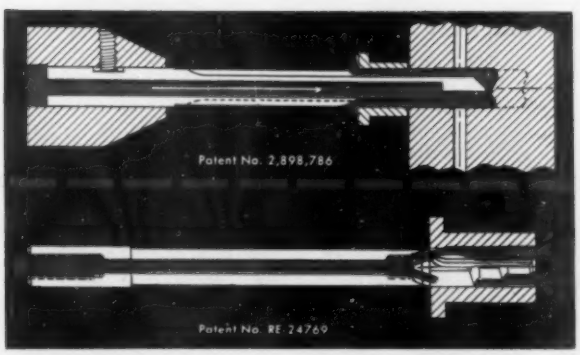
- **Reduced number of operations**
- **Closer tolerance**
- **Improved finish**



Starbore CENTER-CUT TYPE DRILL

Designed for smooth precision drilling of blind or intersecting holes, cored areas, laminated sections or recesses. Off-center pressurized coolant port produces no pin.

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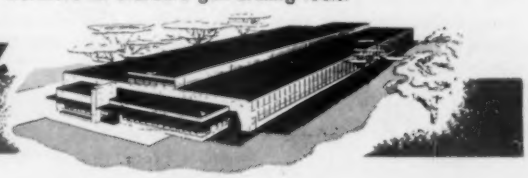
In many cases these high precision tools can ream a die cast or rough-cored hole to a highly accurate, finished, stepped hole in one operation. Note ample purging action of pressurized coolant.

Write for detailed literature on Starbore gun drilling tools.

Star Cutter Company

Originators of Accurate Ungrooved Pack Rolls

24500 GRAND RIVER AVE., FARMINGTON, MICHIGAN



Here's how KENNAMETAL* PUNCHES and DIES can help you COLD EXTRUDE STEEL

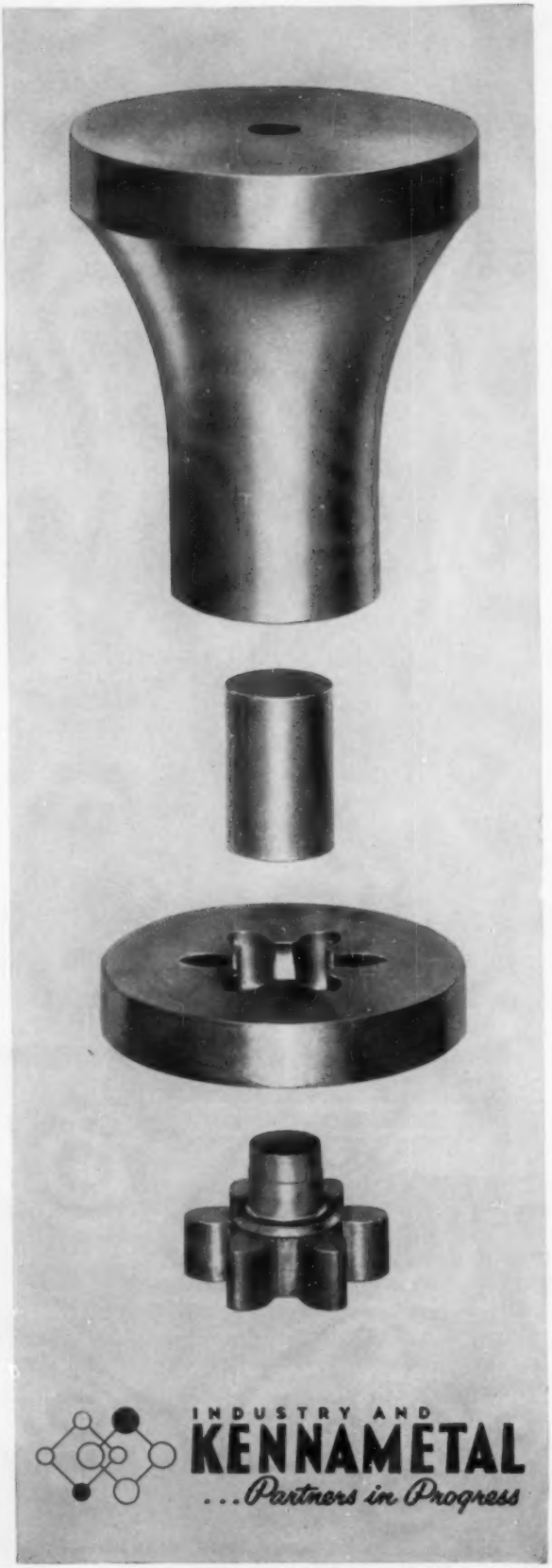
Rigid enough to withstand high compression, but not so brittle it will break . . . that's the combination needed for cold extrusion punches and dies. And that's the combination Kennametal has. For various cold extrusion applications, Kennametal Inc. has developed carbide grades better able to resist deformation from compression during extruding. Also through research and testing, these Kennametal grades have been made better able to resist torsional forces and the high tensile stress during stripping, when the work material tends to cling to the punch.

The fine finish attainable with Kennametal for resistance to galling, plus Kennametal's high resistance to abrasion, help prolong punch and die life even more.

Sometimes punch and die trouble is a *design* problem. Kennametal Carbide Engineers are in constant contact with cold extruders, punch and die fabricators and press manufacturers working out the one best answer to individual problems. If *you* have a problem with punches or dies, why not call in a Kennametal Carbide Engineer? KENNAMETAL INC., Latrobe, Pa.

*Trademark 33584

The Kennametal Punch and Die, illustrated at right, were fabricated by the Ideal Carbide Die Company. Used in a Verson Press, they form automobile door latch pinions from small steel blanks.



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gives you better stainless products!

ALLEN
Stainless Steel Cap and Set Screws

- **NON-CORRODING**
- **HIGH TENSILE STRENGTH**
- **HEAT RESISTANT**
- **BRIGHT, LUSTROUS FINISH**

Allen offers you 190 stock sizes in Stainless Steel Socket Head Cap Screws, now available as standard items in Type 18-8 Stainless or equivalent quality with '60 Series or '36 Series head diameters. Sizes range from No. 0 x 1/8" to 3/8" x 3", inclusive. Smooth heads supplied unless grip heads are specified.

Stainless Set Screws with deep-driving, tight-holding ALLENPOINT are available in 54 standard sizes from No. 0 x 1/16" to 1/4" x 1", inclusive.

When designs call for bright finish and ability to stand up to corrosion, you'll find Allen the answer in the largest range of sizes.

*PRODUCT QUALITY ASSURANCE

PQA, symbol of unquestioned quality at Allen, stands for *constant* quality control from upgrading of incoming raw materials to shipment of *unconditionally guaranteed* finished products.

PQA goes further. It brings you such helpful information as this STAINLESS STEEL DATA (G22) brochure, comparing stainless steel alloys according to advantages, limitations and applications. It lists chemical composition and mechanical properties of 40 widely used stainless alloys; gives comparative corrosion resistance to various media, elevated temperature service data, and other characteristics of stainless steels.

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Genuine ALLEN products are available only through your ALLEN Distributor. He maintains complete stocks close by to help cut your freight costs, inventory, warehousing and handling. He offers fast, single-source service. He knows ALLEN products. And he makes ALLEN Engineering Service available to you. Call him!

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ALLEN HEAD
HEX-SOCKET SCREWS

SOLVOL 900

WATER-MIX CONCENTRATE

WHY BUY A TANK CAR OF CUTTING OIL
THAT CAN BE REPLACED WITH A DRUM OF SOLVOL 900 WATER MIX CONCENTRATE
PLUS WATER SCOT FREE WATER!

PUTS YOUR CUTTING OIL COSTS ON ICE
. . . WATCH 'EM SKID!

Here's why—*SOLVOL 900 is scientifically formulated to contain the maximum amount of lubricity in a water-mix concentrate, without resorting to the use of sulfur, chlorine, or other chemical additives. This super lubricity characteristic provides several economical advantages for cutting fluid users:*

You can ***replace straight cutting oils*** *where tough machining jobs are performed on non-ferrous metals: Tapping—Threading—Broaching—Gear Shaping—Gear Hobbing—Automatic Bar and Chucking machine work.*

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You can ***replace straight grinding oils*** *where high surface finish cylindrical and centerless jobs are performed on Stainless Steels—Monel—High Temperature Alloys—Aluminum.*

And you can use Solvol 900 at ***leaner mixtures*** *for other heavy duty water-mix cutting fluid jobs!*

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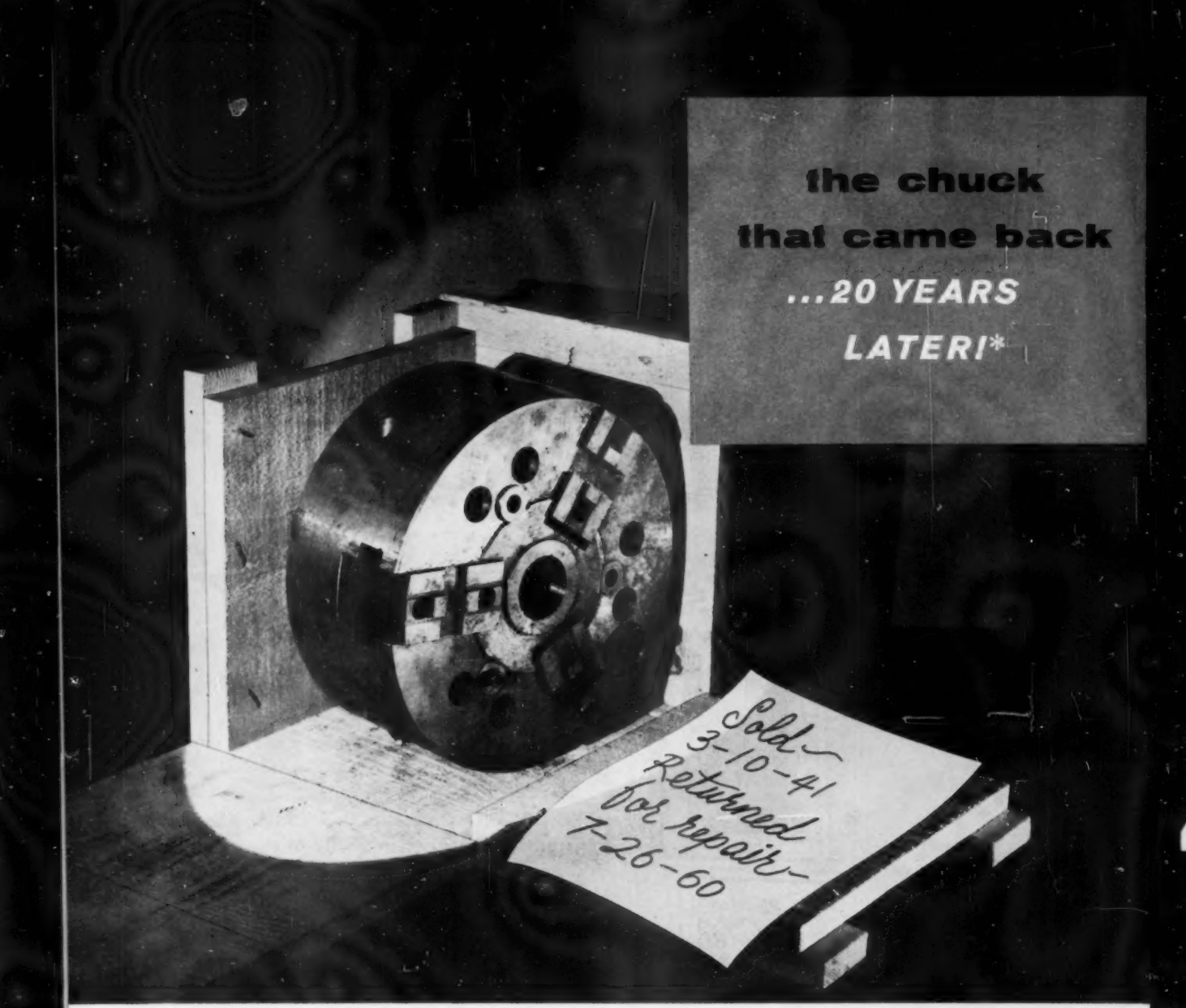

This chuck was returned for refurbishing after 20 years of service!

Actually, this is not an out-of-the-ordinary service record for Logan chucks, because they are built throughout with extra factors of strength and durability to resist deflection, misalignment and wear—and to deliver accurate, dependable and efficient service year after year on any type of operation.

If you would like more information about these rugged, long-lasting air and hydraulic chucks, or any of Logan's other products, just fill out the coupon below.

**Customer's name furnished upon request.*

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AIR AND HYDRAULIC OPERATED MACHINES

Check the items you want, fill in your name and address, tear out and mail to:

Logansport Machine Co., Inc. • 740 Center Avenue, Logansport, Indiana

___100-1 AIR CYLINDERS
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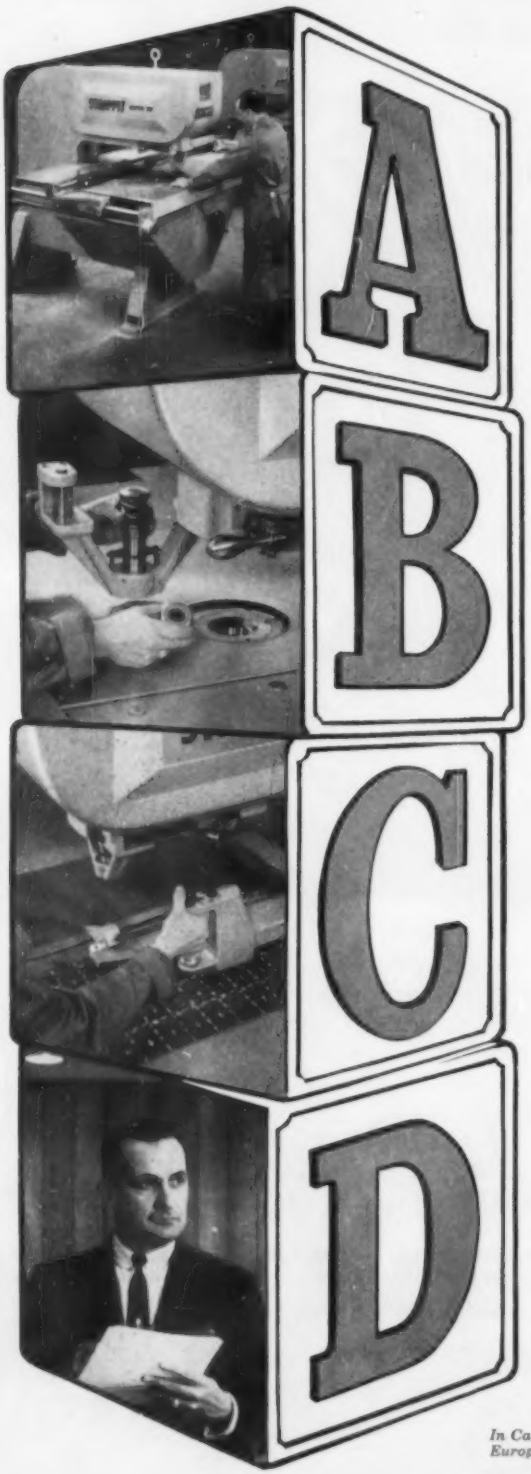
BUILD A BETTER-PRODUCT WITH STRIPPIT SUPER 30 FABRICATOR



A versatile, multi-purpose, single station sheet metalworking machine, the STRIPPIT Super 30 Fabricator punches round and shaped holes in workpieces up to 60″ wide...any length. Will also punch close-centered hole clusters in any material up to ¼″ thick. . nibbles straight or contour lines in ⅛″ material...notches 90° corners, radii and special edge notches to meet most production requirements in material up to ⅛″ thick.

Big savings in time are standard! Change tools in *seconds!* STRIPPIT's Swing-Shift Punch Holders permit you to change punches from either right or left. One size punch and die can be substituted for another in 20 seconds. Workpieces can be positioned rapidly for precise hole location thanks to STRIPPIT'S Micrometric Back and End Gaging System. Set dimensions directly to thousandths.

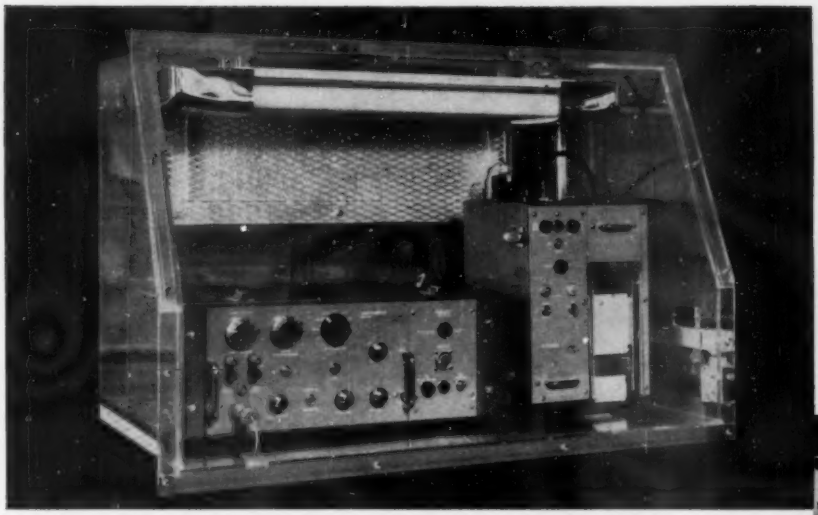
Convert the STRIPPIT Super 30 Fabricator to an efficient medium run production unit simply by adding our Duplicator attachment. Another useful accessory is our Dupl-O-Scope, a high quality optical instrument designed specifically for translating blueprints, drawings, negatives, layouts or sample parts into accurate templates or "one-of-a-kind" finished pieces.

Don't hesitate to call your STRIPPIT Tool & Methods Engineer. He can arrange a demonstration at your plant that will show you ways to cut costs with the STRIPPIT Super 30 Fabricator or other STRIPPIT machines and systems. Write for Catalog 30S.

WALES **STRIPPIT** INC.

211 Buell Road Akron, New York

In Canada: Strippit Tool & Machine Company, Brampton, Ontario; In Continental Europe: Raskin, S. A., Lausanne, Switzerland; In the British Isles: Kearney & Trecker—C.V A. Ltd., Hove, Sussex England.



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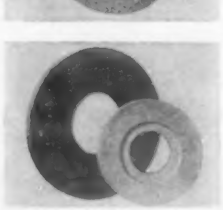
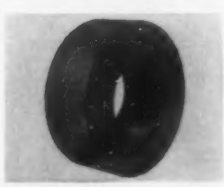
DYNA-GRADED®

Grinding Wheels by MACKLIN

Developed under the direction of the Macklin Research Department





On May 10, at the Production Engineers' Conference at the A.S.M.E. at Toronto, a paper was presented on a method of scientifically determining grinding wheel hardness and uniformity. It involves using the Dynamometer, illustrated above, to *accurately determine wheel hardness and uniformity across the entire cutting face of the wheel under controlled rotating conditions which simulate actual grinding.*

Here's How it Works . . .

Minute amounts of abrasive are crushed from the wheel's cutting surface by a conical, hardened steel wheel which is in running contact with the grinding wheel being tested. The force required to crush these minute amounts of abrasive and bond is electronically recorded on a permanent tape. Any significant variation in wheel uniformity or hardness is recorded on the tape. *This means* Dyna-Graded® wheel characteristics are precisely predetermined *before* the wheel is shipped. This means we can assure you more accurate wheel duplication, order after order. This means better cost control of your grinding operations.

For more than a year, Macklin has been Dyna-Grading wheels. Within a few months, Dyna-Graded wheels will be available for most of your high production grinding operations. Why settle for less? Put Dyna-Graded Macklin wheels to work protecting your production. *For further information, contact your Macklin distributor or write us direct.*

MACKLIN company Jackson, Michigan

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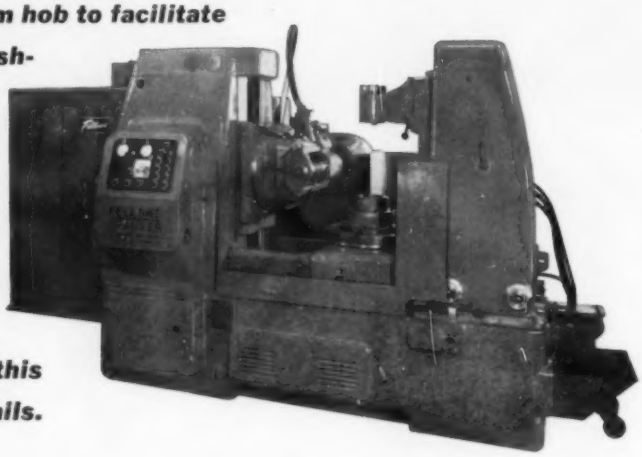
NOW... A Larger Capacity FELLOWS-PFAUTER High-Speed Hobbing Machine... The P 630

You get all the advanced-design features of the production-proved P 400 Fellows-Pfauter hobbing machine — plus extra work capacity — with this new Model P 630. Takes work up to 25″ diameter. Maximum face width at 25″ diameter is 16¼″. Maximum diametral pitch in steel is 3.

Work area is readily accessible for setup and loading, and table retracts automatically from hob to facilitate work changes. Hob shifting is by push-button. It's solid too, with rugged hob head and double wall construction column and bed, and heavy V-ways. Table is as large as maximum workpiece diameter — work column of massive design.



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NEW . . . Dictionary of Change-Gear Combinations

"Fellows-Pfauter Change Gear Tables" by F. Becher and E. Koerner eliminates tedious calculations and trial-and-error methods. Gives combinations for more than 26,000 ratios carried to six decimal places from .100,000 to 1.000,000, with greatest step approximately .00005. Gears in range of 18 to 80 teeth mainly used. Examples are given. Only $8.00. Order from THE FELLOWS GEAR SHAPER COMPANY, 78 River St., Springfield, Vermont, U.S.A.

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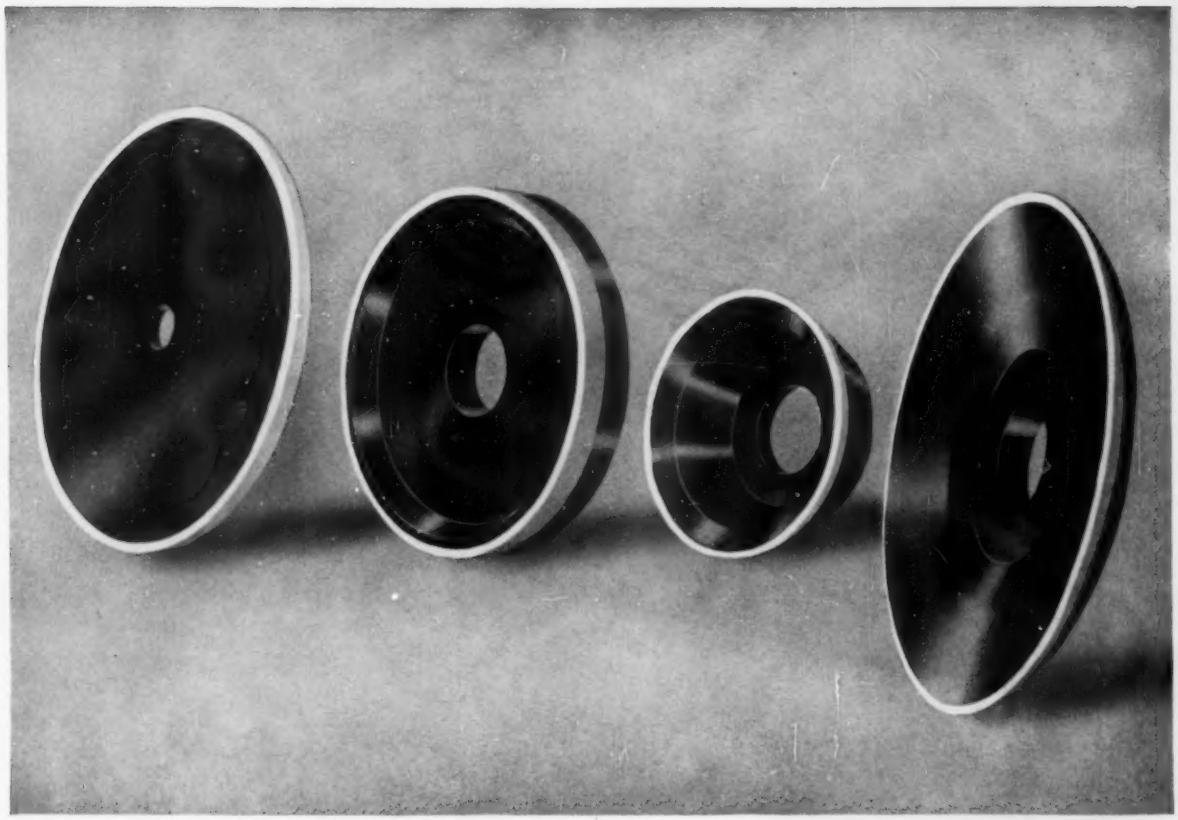
Gear Production Equipment



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Cut Cool and Free—Last Longer

Manhattan Diamond Wheels are engineered to give you faster, cooler cutting and longer life.

Advancements in Diamond Wheel construction and NEW RESINOID BOND developments fully utilize the advantages of both man-made and natural diamond insuring top performance from all Manhattan Diamond Wheels.

TRY Manhattan Diamond Wheels on your toughest application—find out for yourself how they perform in your plant—under your conditions—on your operation.

- New Bonds
- Longer Life
- Bonded for Specific Grinding Requirements
- Natural or Man-made Diamonds

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ENGINEERED RUBBER PRODUCTS ..."MORE USE PER DOLLAR"

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RAYBESTOS-MANHATTAN, INC.

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LIVE CENTERS

meet most turning needs at lowest center point cost

UNIVERSAL models for super accuracy to .0001, high load capacity, perfect for grinding and other high-precision work.

MULTI-DUTY models for general use, perfect for light work, interchangeable parts provide quick changeover for multi-purpose operations.

HEAVY-DUTY models for extra rugged work, give close tolerance results where high load capacity is required, accurate to .0002.

PIPE POINT models for cylindrical turning of pipe, axles and other hollow shapes, six sizes from 3¼" to 7½" dia.

Over 40 sizes...with all popular tapers... in four styles...to choose from. That's how Ideal helps you meet your turning needs for the heaviest work to the lightest of light jobs.

Ideal Live Centers are guaranteed to provide the highest accuracy required, exactly matching the lathe size you use. What's more, they are custom quality designed and manufactured by production methods to give you the lowest possible precision center point costs.

You can get Ideal Live Centers from your distributor's stocks. He'll give you *immediate delivery service*—which reduces your inventory requirements and cuts your investment costs. If you need a special, we'll be glad to work with him to meet your specifications at the *right* price.

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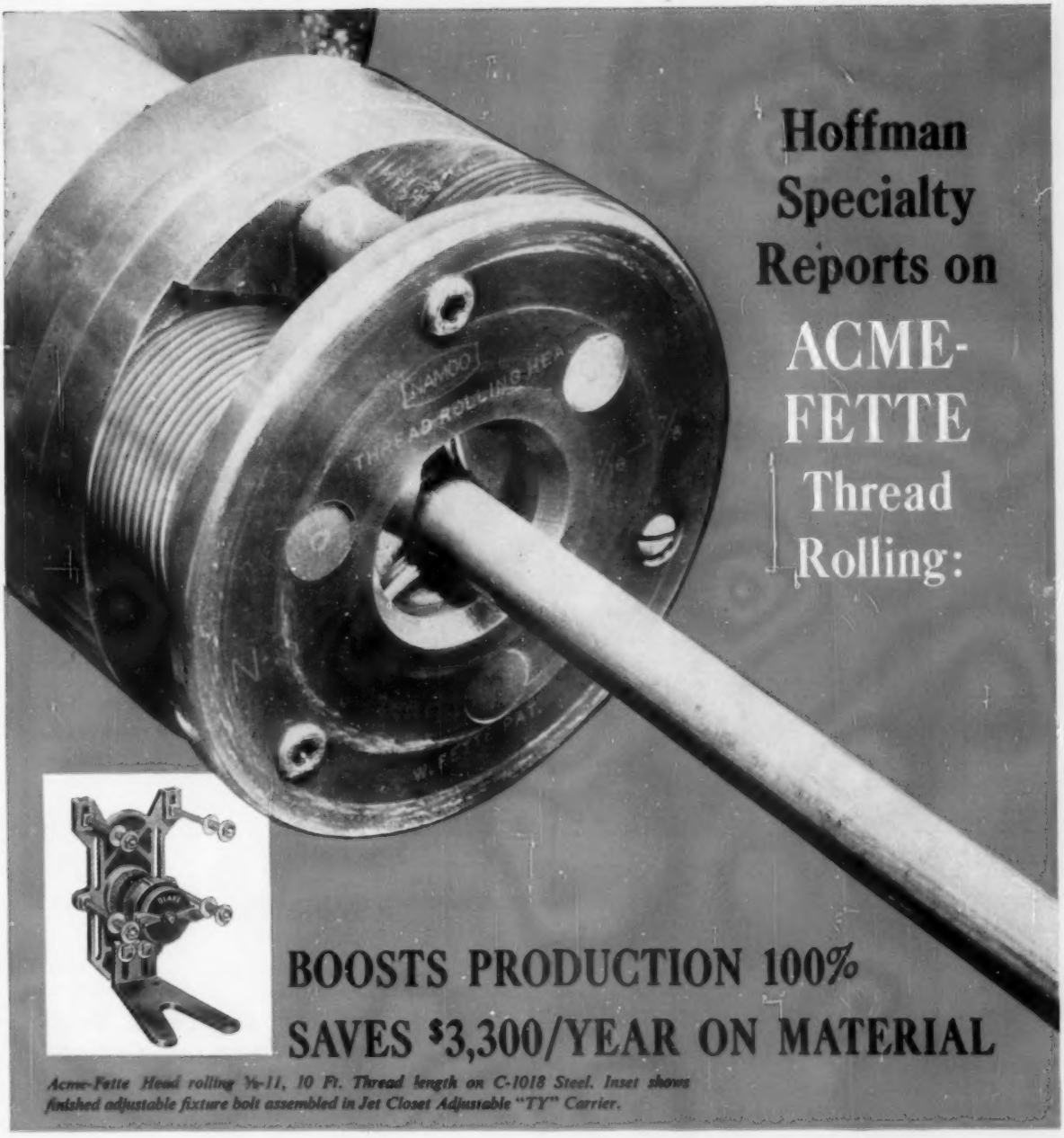
IDEAL INDUSTRIES, Inc., 4152 Park Avenue • Sycamore, Illinois



Acme-Fette Head rolling ¾-11, 10 Ft. Thread length on C-1018 Steel. Inset shows finished adjustable fixture bolt assembled in Jet Closet Adjustable "TY" Carrier.

"Doubled production . . . saved us $3,300 on material alone . . . rolled over sixteen *miles* of thread with same set of rolls . . . produced stronger, more easily-assembled threads with finer finishes . . ." This is the Blake Division of Hoffman Specialty Manufacturing Corporation describing a year's operation with an Acme-Fette N-3 Self-Opening Thread Rolling Head. Such superior performance is easily explained: Because the Acme-Fette Head generates the thread progressively from the front of the rolls, metal flows to the thread's full depth eliminating broken grain structure and cratering at the thread crest. The result is a thread with a high grade burnished surface, remarkably resistant to wear and corrosion. And, Acme-Fette Heads roll any parallel or tapered thread from 1/16" to 2" up to *5 times faster* than thread cutting tools. Get full details. Send for Bulletin NAF-57A.

ROLLED THREADS ARE BEST...ACME-FETTE'S BEST FOR ROLLING

National Acme

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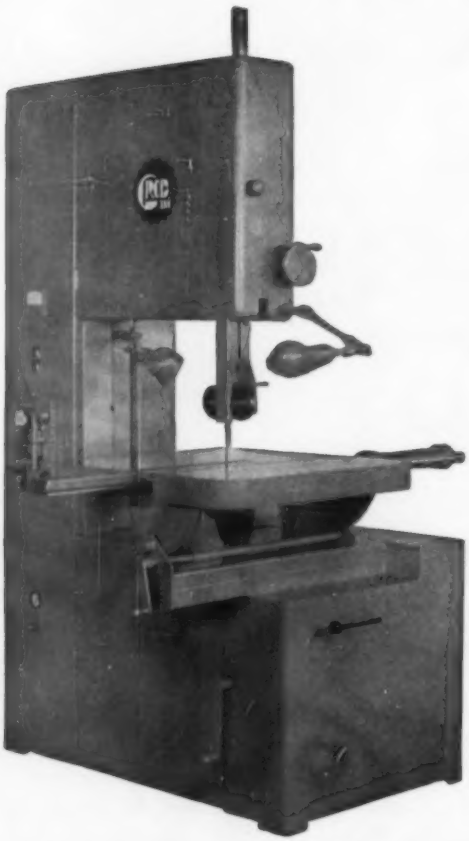
GROB SPELLS THE DIFFERENCE IN BAND SAW MACHINES

The new GROB 24" universal band saw has all the famous GROB features:

Quality • Efficiency • Durability • Strength
Utility • Low Maintenance • Reasonable Cost



- Speeds infinite from 35-12000 FPM covers both cold and hot sawing
- Variable drive 3-speed transmission with precision rolled gears and splines transmits 15 HP
- Hydraulic table feed

See the difference demonstrated in our dealers' showrooms

or

Write GROB INC. for complete specifications

GROB also manufactures a complete line of:

BUTT WELDERS
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Whatever you make . . . there's a

WALDES TRUARC® RETAINING RING

designed to improve your product . . . lower assembly costs

function		for axial assembly					for taking up end-play					
							axial assembly				radial assembly	
nomenclature		basic		heavy duty	inverted		bowed		beveled		bowed e-ring	prong-lock®
series no.		5000 N5000	5100	5160	5008	5108	N5001	5101	5002 N5002	5102	5131	5139
application		Internal for Housings, Bores	External for Shafts	External for Shafts	Internal for Housings, Bores	External for Shafts	Internal for Housings, Bores	External for Shafts	Internal for Housings, Bores	External for Shafts	External for Shafts	External for Shafts
size range	in.	.250 – 10.0	.125 – 10.0	.394 – 2.0	.750 – 4.0	.500 – 4.0	.250 – 1.500	.188 – 1.500	1.0 – 10.0	1.0 – 10.0	.110 – 1.375	.092 – .438
	mm.	6.4 – 254.0	3.2 – 254.0	10.0 – 50.8	19.0 – 101.6	12.7 – 101.6	6.4 – 38.1	4.8 – 38.1	25.4 – 254.0	25.4 – 254.0	2.8 – 34.9	•

function		for radial assembly				self-locking types					
nomenclature		crescent®	e-ring	interlocking	reinforced e-ring	circular self-locking			grip-ring	triangular self-locking	triangular nut
series no.		5103	5133	5107	5144	5115	5105	5005	5555	5305	5300
application		External for Shafts	External for Shafts	External for Shafts	External for Shafts	External for Shafts	External for Shafts	Internal for Housings, Bores	External for Shafts	External for Shafts	With Threaded Screw
size range	in.	.125 – 2.0	.040 – 1.375	.469 – 3.375	.094 – .562	.094 – 1.0	.094 – 1.0	.312 – 2.0	.079 – .750	.062 – .438	•
	mm.	3.2 – 50.8	1.0 – 34.9	11.9 – 85.7	2.4 – 14.3	•	•	•	2.0 – 19.0	•	•

Truarc retaining rings are precision-engineered fasteners which simplify design, speed production and reduce material, machining and assembly costs. They may be used to retain components on shafts and in bores and housings .040" to 10" dia. – and rings as large as 40" dia. have been developed for special applications! Truarc rings are installed in easy-to-cut grooves and self-locking types are available which do not require any preparatory machining. Altogether, there are 50 functionally different types . . . some with as many as 98 sizes . . . in 6 metals and 13 finishes.

More than a fastener! Truarc rings function as mechanical components by replacing machined shoulders, set collars, rivets, threaded fasteners and other bulkier and more expensive fastening devices. They eliminate drilling, tapping, threading and other costly machining operations. Speed of assembly and disassembly further reduces manufacturing costs and simplifies field service.

Assembly tools for every requirement: Truarc offers you the most complete line of pliers, applicators, dispensers and portable magazine-fed tools for high-speed ring installation . . . even fully mechanized and automated equipment for mass-production assembly operations.

Engineering Service: We'll be happy to help you solve *your* fastening problems. Send us your blueprints or contact your local Truarc representative or distributor. They're listed in the Classified Telephone Directory under "Retaining Rings" or "Rings, Retaining."

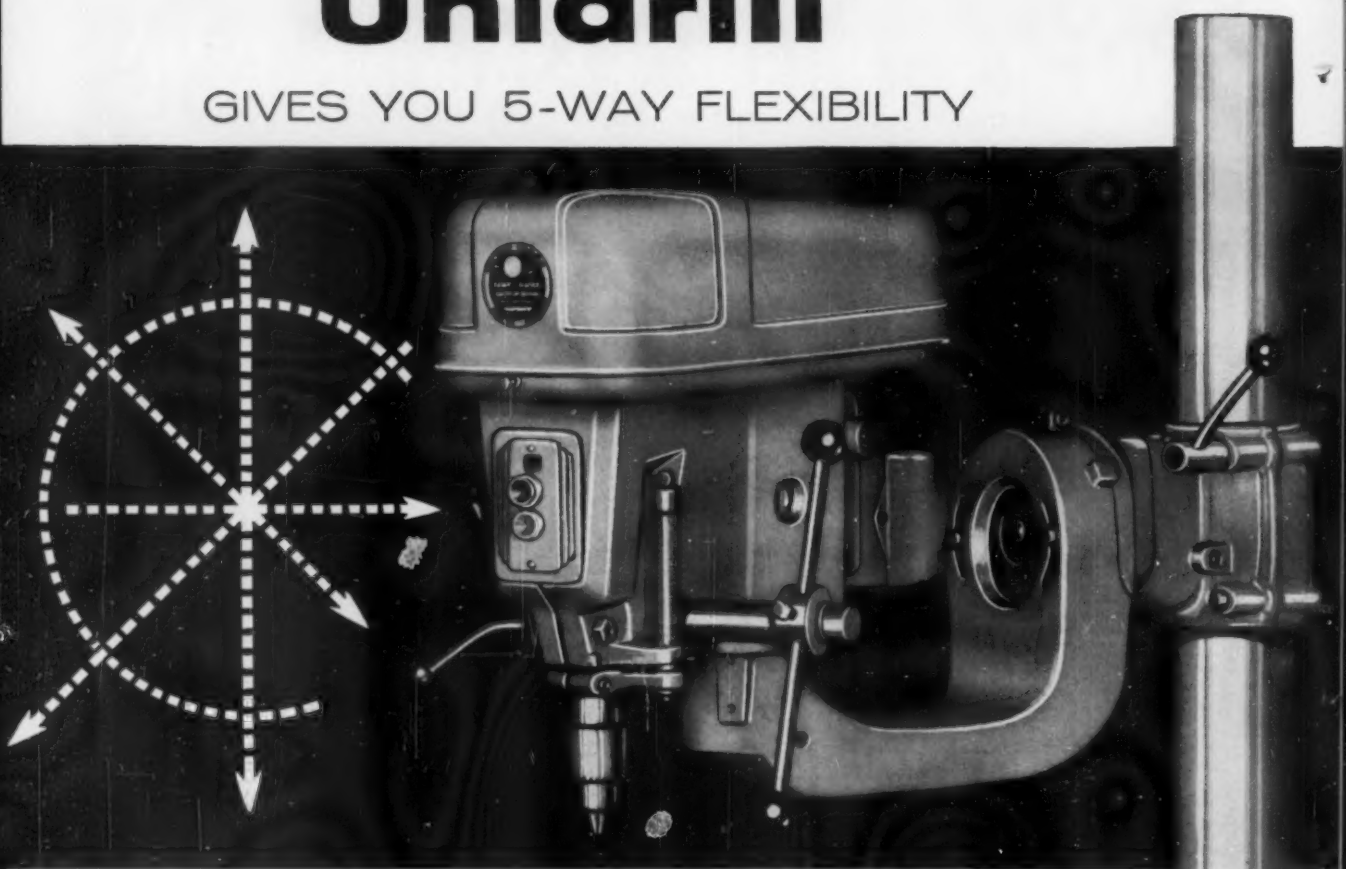
WALDES KOHINOOR, INC.

47-16 Austel Place • Long Island City 1, N.Y.

WALDES TRUARC® RETAINING RINGS

NEW Walker-Turner Unidrill*

GIVES YOU 5-WAY FLEXIBILITY



With the Unidrill you can position the cutting tool to the work in five different ways—move and tilt the drill head to speed the operation, reduce set-up time and eliminate expensive jigs. It's a 2-foot arm radial drill press designed to handle problem drilling jobs—angular drilling, heavy work, bulky pieces requiring extra throat capacity or "reach" of the arm.

You can do reaming, spot facing, counterboring and many other jobs. The Unidrill offers six interchangeable spindles or spindle adapters plus a 12-speed multi-speed attachment that provide even greater versatility.

Ask your Walker-Turner Distributor (listed under MACHINE TOOLS or TOOLS in the Yellow Pages) to show you how the Unidrill can drill to the center of a 48" circle. With one demonstration of this flexibility in action, you'll learn why more people in metalworking call Walker-Turner the *value line.*

FREE BROCHURE shows the full Unidrill line available in floor and bench models with: Utility or Deluxe Head, High or Slo Speed, Key Chuck or Tapered Spindle. Write: Rockwell Manufacturing Company, Walker-Turner Division, Dept. WL-25, 400 N. Lexington Ave., Pittsburgh 8, Pa.

**Trademark*

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"LIGHT-HEAVYWEIGHT" MACHINE TOOLS
another fine product by
ROCKWELL

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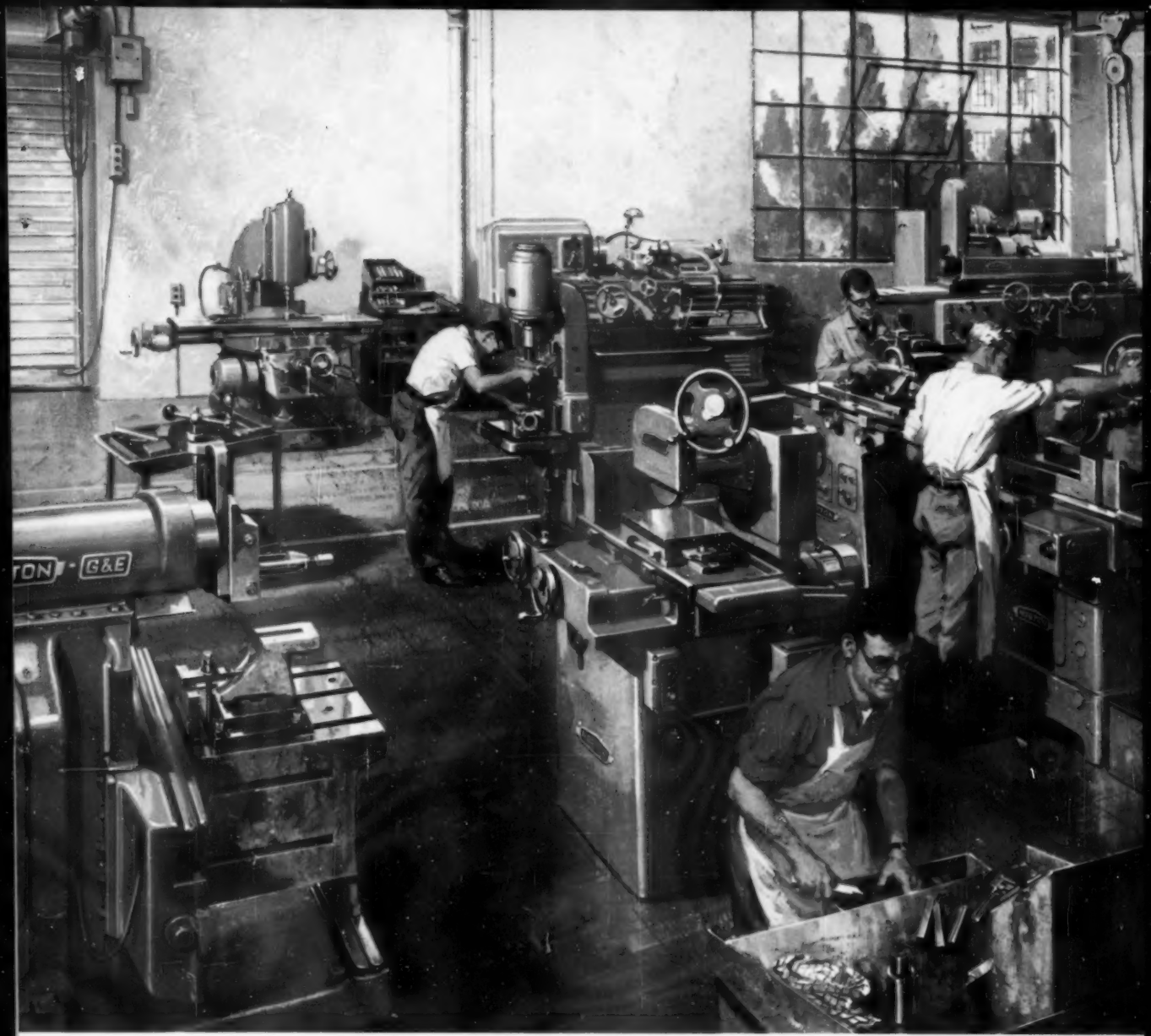

Brightening a tool room with the "Touch of Gold"

Don't let low grade equipment make your tool room a dark spot in your plant operation.

Brighten up with the modernizing, economizing "Touch of Gold" — built into all Norton grinders!

Here you see the five basic types of Norton tool room machines: universal grinders, hand or hydraulic surface grinders, cutter and tool grinders . . . and G & E shapers.

For faster, easier, lower cost grinding, all here include Norton-developed advancements — such as the cutter and tool grinder's tilting wheel head and the hydraulic surface grinder's work table speed of 150 feet per minute.

Your Norton Man will be glad to show you how "Touch of Gold" benefits can be added to your own tool room or production grinding. Or write to NORTON COMPANY, Machine Tool Division, Worcester 6, Mass.

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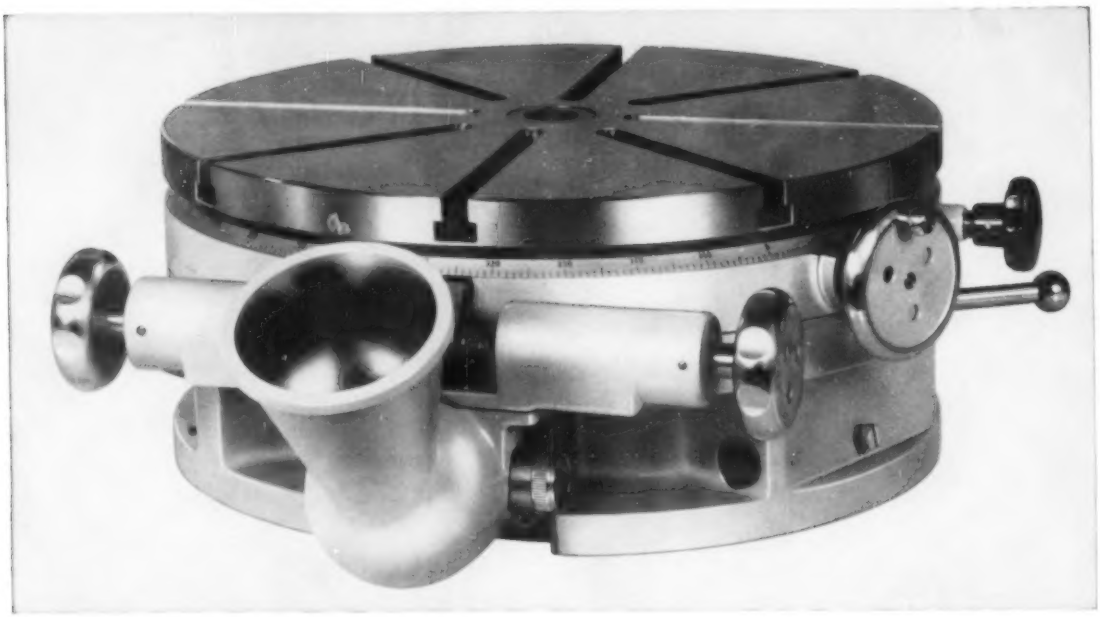
MACHINE TOOLS

Making better products . . . to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Machine Tools • Refractories • Non-Slip Floors — **BEHR-MANNING DIVISION:** Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

NEW Optical Rotary Table



CARL ZEISS

WEST GERMANY

Unlike conventional instruments, the new Carl Zeiss Optical Rotary Table is equipped with a graduated disc, which is imaged on a big, bright ground-glass (80mm diameter). This makes reading most convenient, speedy and non-tiring.

Its large chucking surface of 400mm diameter, precision setting of 6 seconds, and its sturdy construction enable it to meet the most exacting requirements.

Quick, approximate setting is made by means of a handwheel and a circular graduation of 360°, located on the rim of the instrument. The precise setting of the angular values is achieved by a fine adjustment knob while observing the ground-glass.

All mechanical and optical parts are contained in the housing, safe from dust and moisture.

CENTERING MICROSCOPE

True alignment of the machine spindle and axle of the rotary table is assured by a 20x microscope, placed in the machine spindle above a center point inserted in the rotary table. Both the center point and the centering microscope are equipped with a Morse taper 3. Therefore, if desired, the centering microscope can also be inserted in the rotary table and the center point in the spindle.

An epi-illuminating device can be used in conjunction with the microscope.

Write for booklet on the Carl Zeiss Optical Rotary Table

SOME OTHER CARL ZEISS INSTRUMENTS

Universal Measuring Microscope
Toolmaker's Microscopes
Optical Dividing Heads
Interference Microscope
Light Section Microscope
Gauge Block Interferometer
Circular Division Tester
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Technoscope

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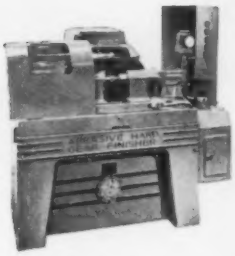
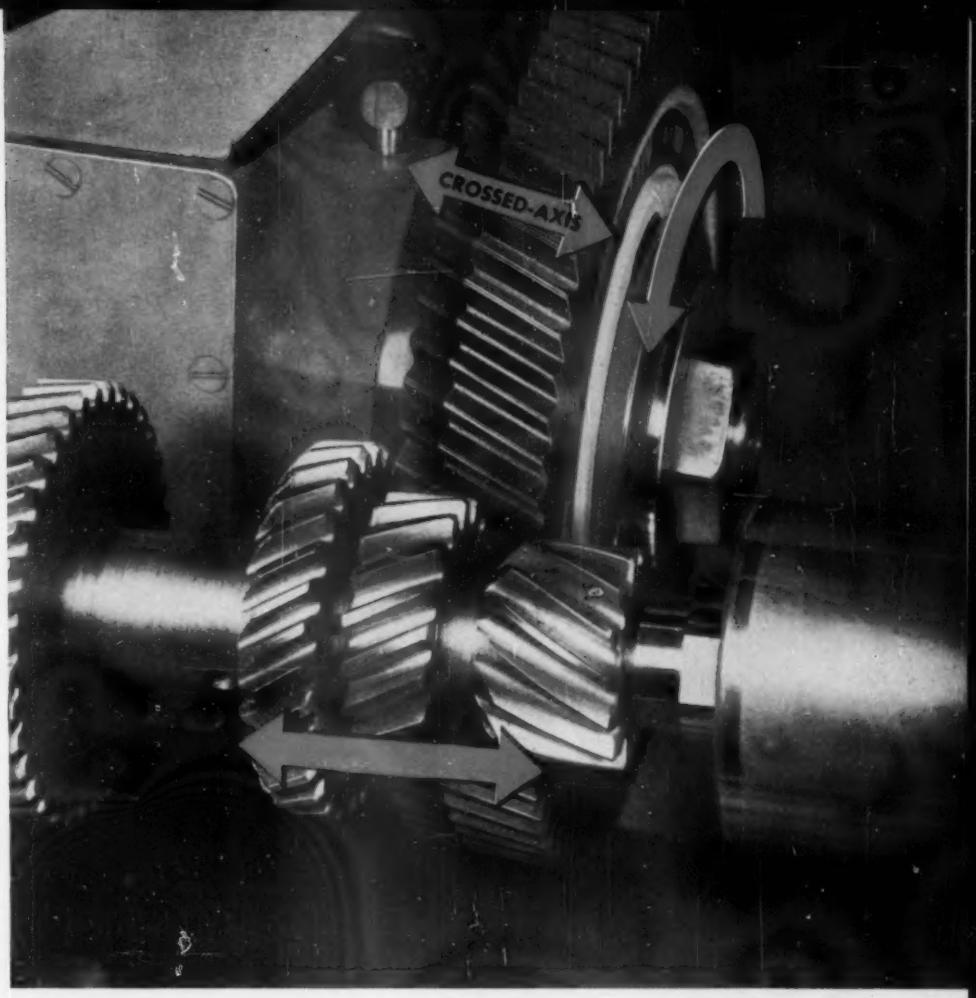
COMPLETE SERVICE FACILITIES

NEW



FOUR-MOTION GEAR FINISHING PROCESS GIVES...



TRUE HONING ACTION!

Smooth hone may be used to finish OD's in certain applications.

The new Michigan 999-A Abrasive Hard Gear Finisher uses four separate but integrated motions to give better surface finish on hardened gears and cylindrical parts. Nicks, burrs, some errors in lead and runout, involute, etc. are quickly corrected with newly developed hones of high-strength plastic available in a wide range of abrasives.

The hone (1) oscillates axially at high speed while (2) the work is reciprocated across the hone, (3) the gear is rotated—under controlled pressure—in mesh with the hone causing (4) sliding action due to crossed-axis of work and hone. This "Four-Motion" process results in smoother, quieter running parts.

Independently variable speeds and up to 25° hone head swivel will accommodate a wide variety of workpieces. Crowning-taper attachment, automatic loader, internal gear attachment and tool dresser are available as optional equipment. For full details write for Bulletin 999-A.

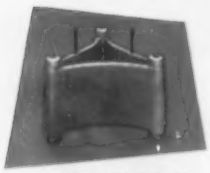
A head modification kit to convert Michigan Model 999 to the new process is available.

MICHIGAN TOOL COMPANY, 7171 E. McNICHOLS RD., DETROIT 12, MICHIGAN

Use Reader Service Card. CIRCLE 63

7 PLA-CHEK GAGES stand guard over Ford precision and accuracy in this Layout and Inspection room at Ford Motor Company's Dearborn engine plant in Dearborn, Michigan

7 of 200 Reasons Why Inspections are *Faster at Fords!*



PRECISION RISERS

Built with the same precision as the gages themselves, PLA-CHEK Gage Risers may be used to extend the usefulness of every PLA-CHEK Gage from the smallest to the largest size. Available in 6" height for 6", 12", 18" PLA-CHEKS . . . 12" height for 24", 36", 48" models.

MICROMETER THIMBLE

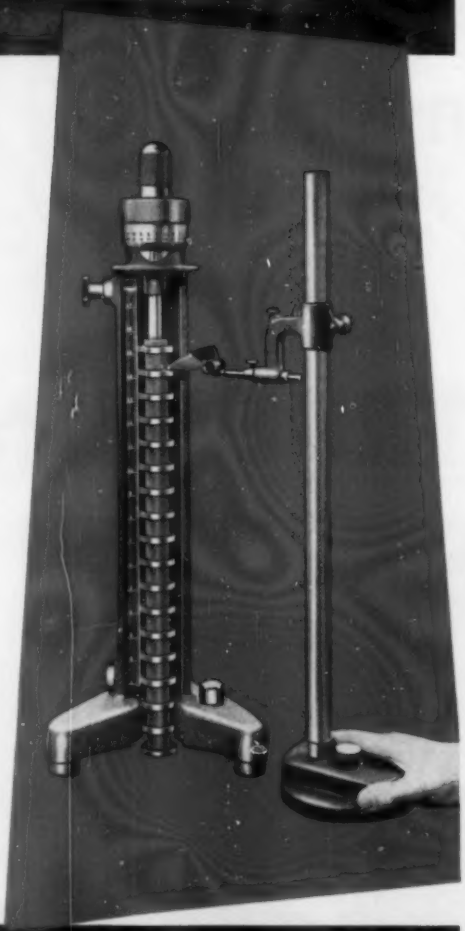
is graduated to .0001" and provides dimensions between 1" steps on measuring bar. Measuring bar of the 18" model (as illustrated) and larger models, can be adjusted to enable the user to take readings up or down relative to a center line or other reference line on the work.

PLA-CHEK GAGES Guard Ford Precision while Cutting Inspections from Minutes to Seconds

Precision is a law at Ford Motor Company. And speed is essential to the maintaining of high volume production. That's why you'll find more than 200 PLA-CHEK Gages at work in various Ford plants speeding inspections while guarding Ford precision and quality.

PLA-CHEK GAGES, available in a full range of sizes to meet every surface plate inspection and layout requirement, can be set 5 to 20 times faster than other methods of comparable accuracy. They are guaranteed accurate to .00005" throughout the entire range of the 6", 12" and 18" sizes and in the 24", 36" and 48" sizes to .0001" in any 24" length or .0002" over their entire range.

In August, 1946 Ford Motor Company purchased its first PLA-CHEK Gage. Today there are 200 at work in Ford inspection rooms and at Ford machines. Such confidence on the part of Ford Engineers must be deserved. Let us tell you how you, too, can speed inspections, maintain extreme accuracy and save money with PLA-CHEK Gages. Write for complete, detailed literature.



Cadillac GAGE COMPANY

P. O. BOX 3806 • DETROIT 5, MICHIGAN

NEW Simonds Comfort-Grip Handle

American-Swiss® Needle Files

For fine die and toolmaking, Simonds new PLASTIC-HANDLED Swiss Pattern Needle Files provide more positive grip and real comfort. Make intricate filing easier and less tiring.

Safer, too, they can't slip, scratch or cut filer's hand — eliminate make-shift handles, pads, tape, etc.

Set of twelve different shapes, furnished in handy "hang-up" or "fold-away" plastic kit, adds convenience, comfort and safety to well-known Simonds Needle File quality.

Now available from your Simonds Distributor as part of the full line of Simonds Swiss Pattern Files.

Size	Cut
4"*	0, 2, 4, 6
5½"	0, 2, 4, 6
6¼"	0, 2, 4, 6

*In 4" length, Oval is furnished instead of Crossing.

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FITCHBURG, MASSACHUSETTS

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Factory Branches in Union, N. J., Chicago, Shreveport, La., Los Angeles, San Francisco, Portland, Ore. • Canadian Factory in Granby, Que. • Simonds Divisions: Simonds Steel Mill, Lockport, N. Y.; Heller Tool Co., Newcomerstown, Ohio; Simonds Abrasive Co., Philadelphia, Pa. and Arvida, Que., Can.

Use Reader Service Card, CIRCLE 65

HOW TO INCREASE COSTS A FEW DOLLARS AT A TIME

Under the guise of "cutting costs" you may save pennies while having dollars picked right out of your pocket. Just close your eyes to the productive potential of a machine. Use relatively ineffective working components and overall costs will be increased a few dollars at a time.

Cutting tools for milling machines are sometimes a good example: The purchase of the machine represented a sizable expenditure. It was justified because of the work it was expected to do, the contribution it was expected to make to the company's profit. Then someone got the

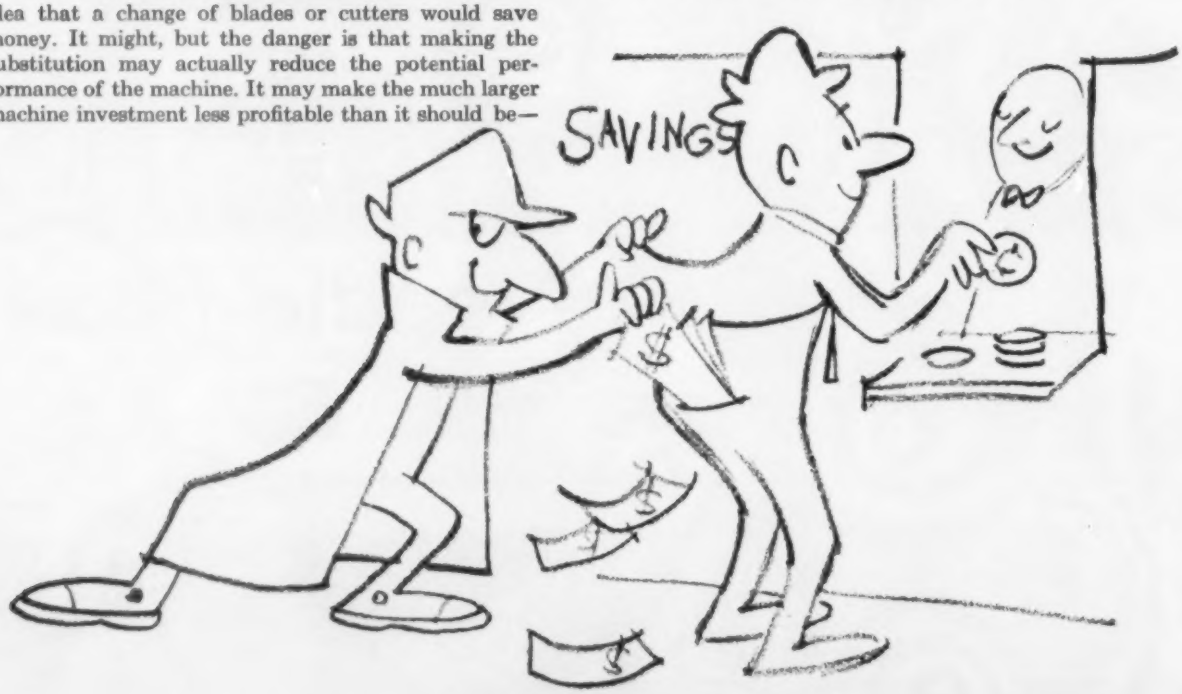
All types of cutting tools are production-run tested at Ingersoll

idea that a change of blades or cutters would save money. It might, but the danger is that making the substitution may actually reduce the potential performance of the machine. It may make the much larger machine investment less profitable than it should be—may *in total* increase annual overall costs, rather than reduce them. The total effect can only be known after a complete analysis of all of the factors involved.

There's a way to be sure you're NOT increasing costs a little at a time—to be sure you ARE getting maximum machine and cutter performance and minimum costs at the same time.

Ingersoll has one of the best milling cutter and blade testing laboratories in the world. It is the shop where Ingersoll builds, erects and tests special machines. Here milling cutters and blades of virtually every type and kind are continually being evaluated. The Cutter Division's blade and cutter design and manufacturing facilities are unsurpassed.

However, the true test of cost and performance must incorporate all the conditions and objectives in each user's shop. Ingersoll is equipped and prepared to help the customer determine the *right* blade or cutter for each requirement and to supply them at the *right* place and at the *right* time. Ask to have an Ingersoll sales engineer tell you about the Ingersoll Cutter Service and the Blade Back-Up Program. Write: **The Ingersoll Milling Machine Company, Cutter Division, 505 Fulton Avenue, Rockford, Illinois.**



IT'S A FACT!

DRILLHEADS
ARE OBVIOUS.

Tremendous economies from the use of multiple-spindle drillheads are obvious. Drilling one hole at a time cannot be tolerated in this day of automation!

THOMSON
THRIFTMASTER
Drillheads
are your best Drillhead buy...

1. They are better built and cost no more (Full ball bearing construction, hardened gears, spindles and driver, and precision grinding!)
2. This means they last longer
3. This eliminates down time
4. This eliminates production losses
5. This drastically reduces drilling costs

THOMSON
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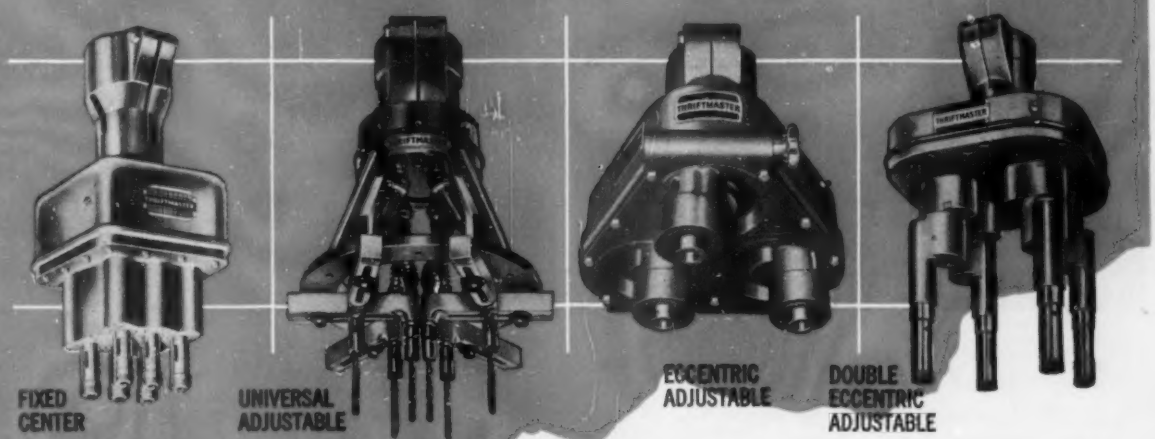
Drillheads are designed and produced by engineers whose experience **in this specific field** dates back to 1923. This long accumulation of engineering technique and production "know-how" is reflected in our product—**a quality tool... solid, substantial and dependable!**



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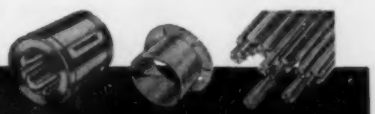

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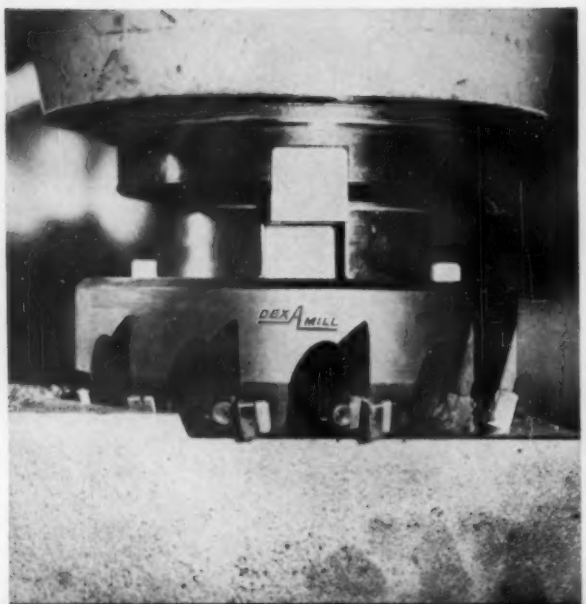
Adamas Carbide introduces

...FOR OUTSTANDING MILLING EFFICIENCY ON CAST IRON...

NEW GRADE AM



FOR ROUGHING . . . A Midwestern manufacturer of engines, power units, tractors and trucks, using an 8" Adamas Dex-A-Mill with Grade AM inserts on cast iron, takes a 6" wide cut ⅛" to ⅜" in depth at 300 sfm . . . feed per tooth .010" per revolution.

FOR FINISHING . . . An Eastern manufacturer of typewriters and data processing systems uses a 6" Dex-A-Mill with Grade AM inserts on cast iron to take a 5" wide cut ⅛" in depth at 500 sfm . . . feed per tooth .001" per revolution . . . work finish 40 rms.

"Boosts output" . . . "Reduced my milling costs" . . . "Best general-purpose cast iron milling grade we ever used" . . . say tool engineers after their experiences with Adamas Grade AM on a wide variety of milling operations — using throwaway insert, inserted blade and brazed type milling cutters.

Grade AM's exceptional combination of metallurgical properties (hardness, strength, crater resistance) assures maximum tool life whether used for roughing or finishing.

Use Adamas Grade AM — it will help reduce your manufacturing costs. In-plant demonstrations are easily arranged.

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Tool Tips
Dies, Wear Parts
Dex-A-Tool
Dex-A-Mill

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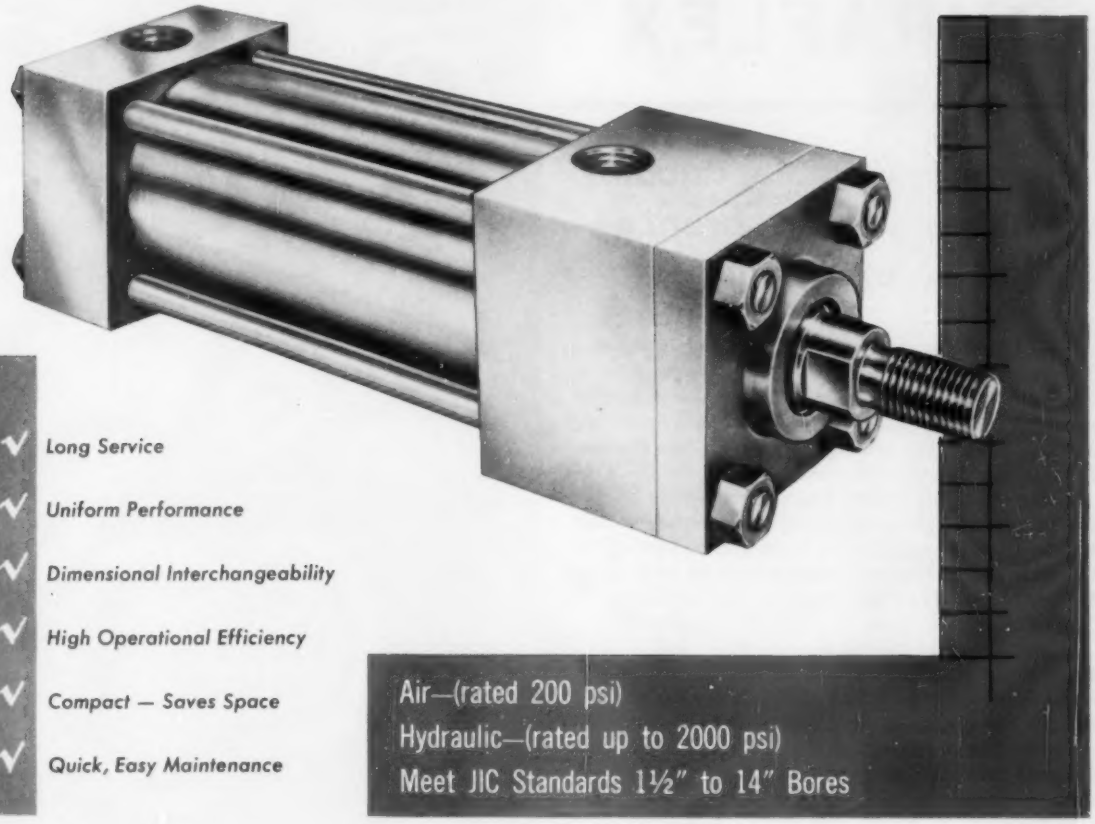
PROGRESSIVE CARBIDE USERS SELECT BY *Performance*...NOT HABIT!

NEW O-M SQUARE-HEAD AIR AND HYDRAULIC CYLINDERS GIVE THE PERFORMANCE YOU EXPECT . . . AND MORE



- ✓ *Long Service*
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- ✓ *High Operational Efficiency*
- ✓ *Compact — Saves Space*
- ✓ *Quick, Easy Maintenance*

Air—(rated 200 psi)
Hydraulic—(rated up to 2000 psi)
Meet JIC Standards 1½" to 14" Bores

Made of the highest quality materials and seals, these new components combine modern design, the latest and best engineering advancements with O-M specialized "know how" and precision workmanship.

New Series "K" Air Cylinders

Construction features include brass cylinder barrel, chrome-plated, high tensile steel piston rod with a minimum yield strength of 90,000 to 100,000 psi. Rolled and machined steel heads and extra long cartridge-type rod bearing assure perfect alignment of piston rod.

New Series "L" Hydraulic Cylinders

Similar in many construction features to Series "K", but specifically designed for hydraulic service. Incorporate vee-type rod packing and a cylinder barrel of micro-honed steel tubing which are best suited for hydraulic operations.

With the addition of the new Series "K" and "L" to the Ortman-Miller major line of air and hydraulic cylinders, you can now rely on O-M for *all* of your low and medium pressure cylinder requirements. Both Series "K" and "L" are dimensionally interchangeable with other cylinders of a like type. Fabricated, precision steel mounts and accessories assure precise mounting.

Mail coupon today for complete details. All cylinders in Bulletins 115A and 116 have been dimensioned in accordance with NFPA recommendations for your convenience.

ORTMAN-MILLER MACHINE COMPANY
13 143rd Street, Hammond, Indiana

☐ Have representative call
Please send Bulletin(s)
☐ 115A–Series "K" ☐ 116–Series "L"

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the more durable, ductile, flexible phosphor bronze—at no extra cost

Here is one of the most versatile of phosphor bronzes. The superfine-grain structure of Duraflex provides a considerable improvement in fatigue life over regular phosphor bronze. Now you can obtain higher endurance limits with greater formability. It's ductile. It's resilient. It's corrosion-resistant!

This new, higher quality Anaconda phosphor bronze is now available in several standard phosphor bronze alloys—in strip metal up to 0.062″ thick and up to 14″ wide in all standard tempers, and in wire up to 3/16″ diameter. Duraflex strip is also available in long rolls.

Within the capabilities of size and alloy composition, Duraflex strip and wire can be applied to the innumerable uses for which conventional phosphor bronzes are employed, and in most instances provide longer and more efficient service. *Yet Duraflex sells for the same price as regular phosphor bronze in the same alloys and forms.*

Publication B-38 tells the story. Write for your copy—or for any assistance from our Metallurgical Dept. in selecting the proper alloys for your metalworking projects. Address: Anaconda American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario. 61-1148

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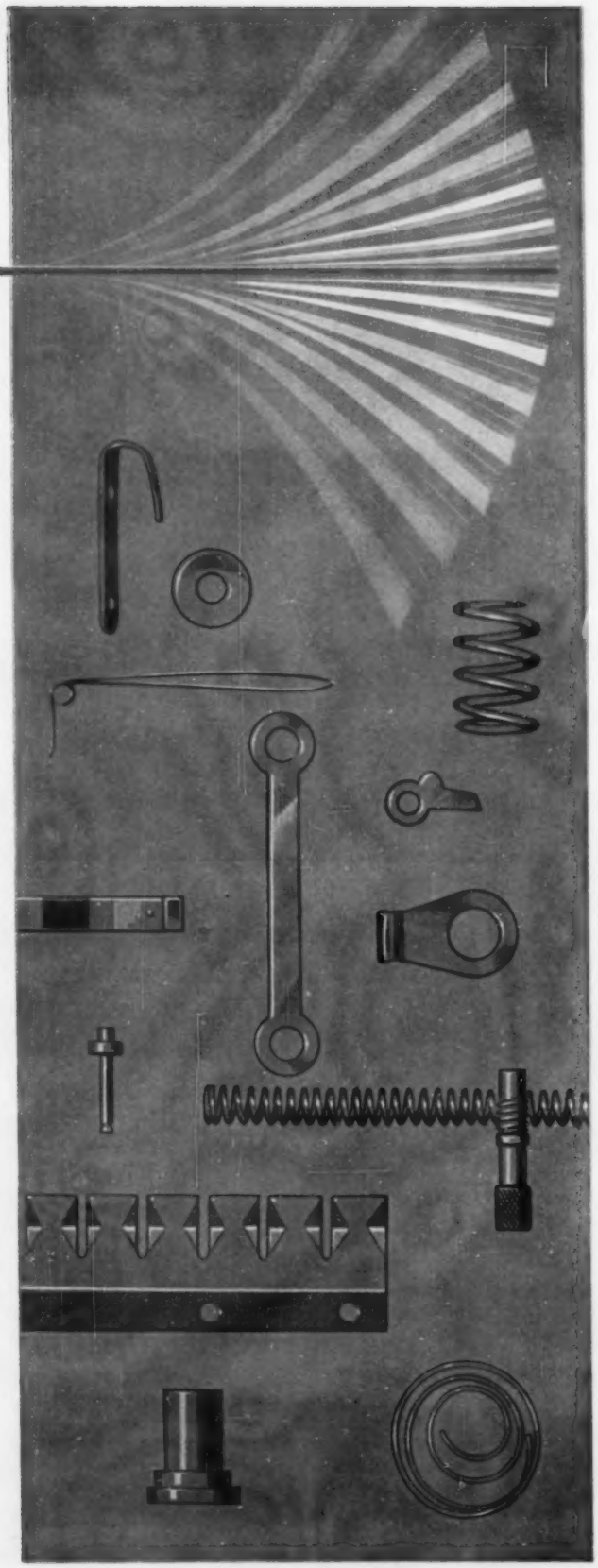
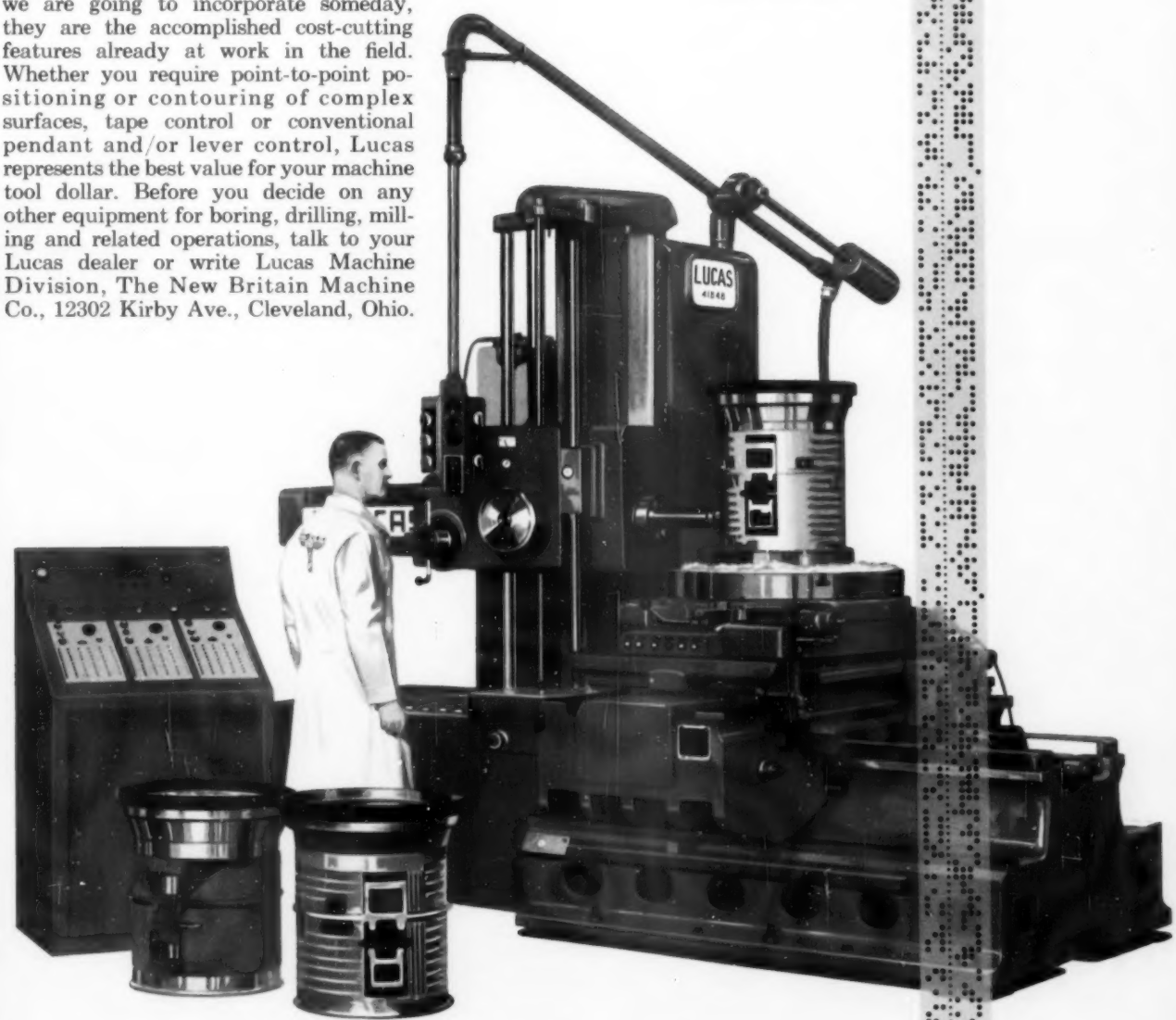


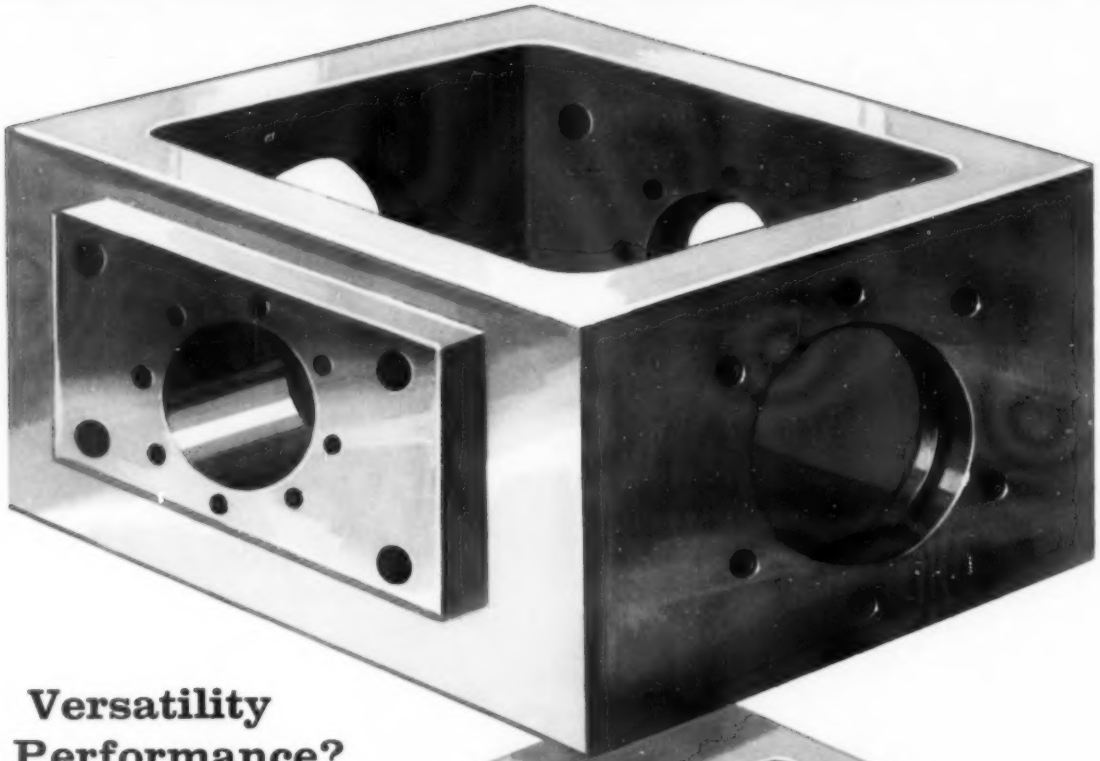
Saddle feed?

LUCAS

. . . plus precision flame-hardened column, table and saddle ways; a full range of speeds and feeds; maximum rigidity for precision machining accuracy on the heaviest cuts; air-lift to saddle and table during rapid traverse and every other major design and construction feature is available on Lucas boring, drilling and milling machines. These aren't the things we are going to incorporate someday, they are the accomplished cost-cutting features already at work in the field. Whether you require point-to-point positioning or contouring of complex surfaces, tape control or conventional pendant and/or lever control, Lucas represents the best value for your machine tool dollar. Before you decide on any other equipment for boring, drilling, milling and related operations, talk to your Lucas dealer or write Lucas Machine Division, The New Britain Machine Co., 12302 Kirby Ave., Cleveland, Ohio.

LUCAS
PRECISION





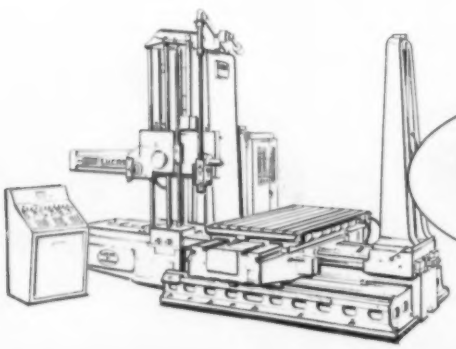
Versatility of Performance?

LUCAS

Lucas offers the widest range of machining operations possible on boring, drilling and milling equipment. The same versatility of application applies to work ranging from precision missile components to big castings and forgings weighing tons . . . on models ranging from 2¾" to 7" spindle diameter.

Point-to-point positioning. Milling (face milling, picture frame milling, right angle milling), boring (line and stub), drilling, tapping, threading, plus *contouring and profiling of complex surfaces.* Repetitive accuracy to ±.0001.

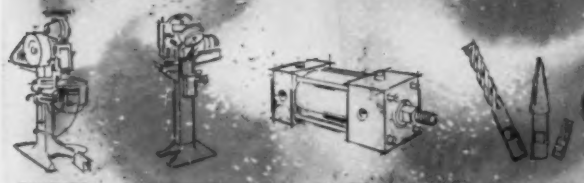
If your replacement or expansion plans include the addition of either vertical or horizontal table type or floor type boring, drilling and milling equipment, get the details on what Lucas has to offer. Lucas Machine Division, The New Britain Machine Company, 12302 Kirby Avenue, Cleveland, Ohio.



LUCAS
PRECISION

BIG NEWS

The T-J Spacemaker cylinder line is not now, nor ever has been, a probe into outer space. It is offered as a practically designed, research engineered and time tested product. Its Spacemaker feature (no tie-rods) and rugged construction gives greater strength, saves space and reduces costs in all power drive applications. The Spacemaker is available in a complete range of bore sizes and strokes, air or hydraulic, and contains many *plus features* and extras as STANDARD . . . NO EXTRA COST! Write Tomkins-Johnson, 2425 W. Michigan Ave., Jackson, Mich. for Bulletin #155-4 and for full particulars, today.



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Lock paint on . . . lock corrosion out: ALL Oakite CrysCoat processes do both by converting a steel surface into an integral "toothed" layer of rugged phosphate crystals. Yet they're different enough to let you *job-match* a pre-paint treatment to the product service conditions and to your production setup—for *lowest unit costs.*

There's a spray-wash or tank immersion phosphate treatment for saving on heating costs . . . for easy control . . . for faster production . . . for smoother paint films . . . for heavy duty protection. Pick the ONE that's right for you.

Oakite CRYSCOAT 47: heavy, fast-coating iron phosphate. Iron phosphating at its best. Cleans off average fabricating oils and soils as it phosphates; produces a premium quality coating. Increases corrosion resistance. Conserves spray washer time. Bulletin F-10058C.

Oakite CRYSCOAT 87: smooth, paint-saving iron phosphate. Spray setup uses only 3 stages. Saves time, equipment; easy to control. Doubles the 250 hour specified minimum of salt spray resistance. Bulletin F-10300.

Oakite CRYSCOAT 187: NEW—iron phosphate treatment. Specifically designed for application by tank immersion. Provides new detergent and solvent action to assure greater cleaning efficiency . . . more thorough removal of smut from steel. Has built-in pH control. Offers longer solution life.

Oakite CRYSCOAT 89: economical, iron phosphate. Works in spray washing machine without foaming. Easy to control, requires no stainless steel equipment. Bulletin F-10301.

Oakite CRYSCOAT HC: heavy duty zinc phosphate. For tank application. Creates a heavy zinc phosphate coating for severe service conditions. Exceeds the 150 milligram per square foot requirement; up to 1200 milligrams obtainable. Bulletin F-10305.

Oakite CRYSCOAT SW—single package zinc phosphate. No outside accelerators needed. Easy to control. For spray washer or tank application. Coatings meet Government specification MIL-C-490A Grades I and III. Offers long solution life. Bulletin F-10309.

Oakite CRYSCOAT MP—heat-saving zinc phosphate. Produces zinc phosphate coating at low temperature, on steel cadmium and zinc. Keeps sludging to a minimum. For spray washer or tanks. Bulletin F-10768.

Oakite CRYSCOAT FG—smooth, dense zinc phosphate. Develops a fine grain zinc phosphate coating. Spray washer or tank immersion. Low to moderate temperature process. Promotes a smooth paint finish. Bulletin F-10767.

The local Oakite man offers his technical service on a local basis—promptly. There are 250 like him—experienced in all phases of phosphating and its benefits. Call him in, or write for the bulletins mentioned under each process description. Oakite Products, Inc., 17 Rector Street, New York 6, N. Y.

OAKITE

over 50 Est. 1909 SCIENCE years' leadership in industrial cleaning

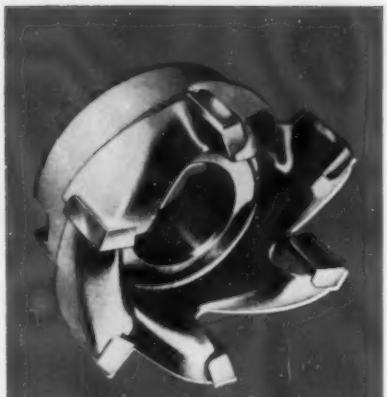
Longer-lasting: These two panels were identically painted; scored with an "X" and exposed to salt spray test for 480 hours. The big difference: right-hand panel was first treated with an Oakite CrysCoat iron phosphate coating.

Better-looking: This tubing was CrysCoated, painted, and then subjected to repeated punching. Despite the severe abuse, paint film still grips tight—*still* looks good.

SANDVIK Coromant

Exclusive "Tooth-Saver" Design Increases Cutter Life 40%

- Surface speed range from 100 to 800 ft. per min. depending on application
- Special design features make them usable on machine tools where conventional carbide mills cannot be used



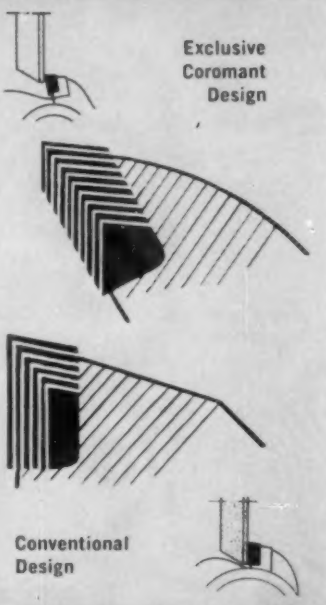
Coromant S 26 Carbide-Tipped Shell End Mill. For face milling and square shoulder milling. In 3 sizes

40% LONGER TOOL LIFE + FASTER, EASIER REGRINDING

You simply grind a suitable primary land along the cutting edge rather than taking off the entire top surface of the blank as required by conventional mills. Coromant saves time and grinding wheels. Since you grind the length of the insert rather than the cross section, you retain far greater tip thickness for the life of the cutter than is possible with conventional designs.

EASIER, MORE ECONOMICAL CHANGE OF RADIAL RAKE

Coromant cutters have extra "angle capacity" . . . require less carbide removal . . . are more easily applied to the difficult machining jobs **including the new, exotic metals.**



Exclusive Coromant Design

Conventional Design

For complete data on all sizes of these Coromant mills ask for this free folder.

Coromant S 27 Carbide-Tipped Shell End Mill. For heavy duty face milling. In 3 sizes.

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MIKRON TYPE 21/0

HYDRAULIC GEAR HOBBING MACHINE

precision **PLUS** *production*

"THREE MACHINES —one basic unit"

1. HAND LOADING
2. SEMI-AUTOMATIC MAGAZINE LOADING
3. FULLY AUTOMATIC HOPPER LOADING

FEATURES:

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- Automatic part deburring
- Low cost tooling
- Simplicity of set-up and quick change-over

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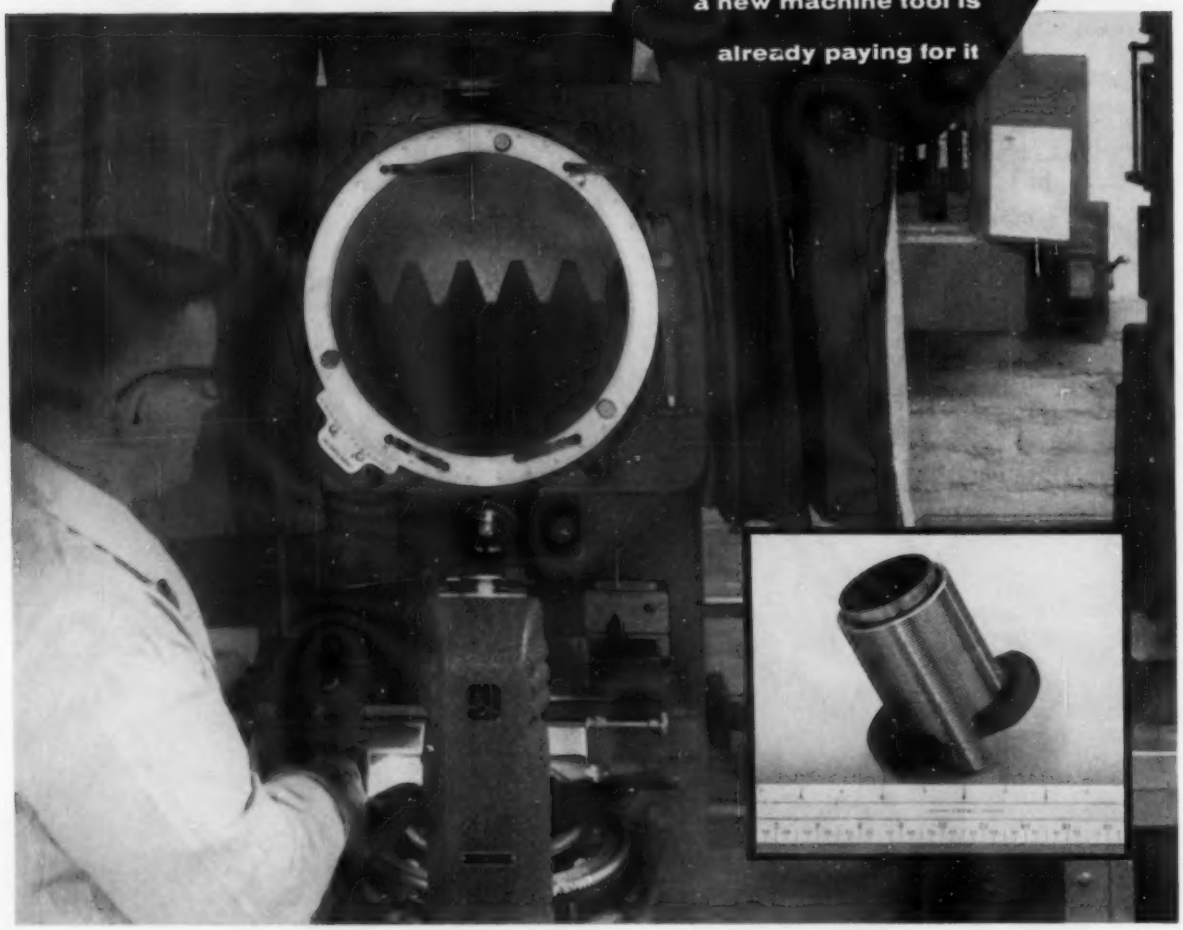
the man who needs a new machine tool is already paying for it



Unretouched photo (above) shows this cylindrical rack being inspected at 62.25X. Photo, courtesy of Baird-Atomic Inc., Cambridge, Mass.

4000% Increase in Inspection Efficiency through use of a J & L Optical Comparator

Baird-Atomic, Inc., Cambridge, Mass., manufacturer of scientific and research instruments needed a rapid and precise method for the quality control measurement and inspection of various components. After experimentation with various types of inspection equipment, a J & L FC–14 Optical Comparator was given a trial. It met all requirements perfectly.

The inspection of a cylindrical rack, heart of the Baird-Atomic Periscopic Sextant, used in advanced aircraft, gives an illustration of the J & L Comparator's efficiency.

The rigid quality control tolerances for this part include: tooth-to-tooth tolerance, .0002″; tooth-to-tooth error, .0003″; composite error, .0003″; pitch dia. within .0005″; concentricity within .0005″ TIR.

Adequate inspection and measurement by conventional methods proved laborious and time-consuming: inspection rate was little better than one rack per day. Now, using a J & L FC–14 Optical Comparator, average inspection rate is 42 per day, an increase of approximately 4000%!

Investigate the possibilities of J & L Comparators in *your* production set-up. Available in 12 different models, both floor and table types.

Write today for Comparator Catalog 5700. Jones & Lamson Machine Company, 518 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

The Future Is Now

This morning, while you were shaving, something happened.

Something that happens every day, but no one notices it.

The future becomes the present. The day you've been planning for has arrived. Things you've been putting off for the future must be done now. The day of reckoning has arrived for postponed projects. Your procrastination has finally caught up with you.

All of us plan for the future and those plans are a good thing. They give us a target to shoot for. But we shouldn't let plans for the future get in the way of real accomplishment today and every day.

Are you planning to investigate some new processes or machines that could be installed in your plant to achieve higher productivity? Are you going to do it tomorrow or next week? Do it today, to bring that desired productivity one day closer to reality.

Are you planning to read some articles on numerical control sometime to get the latest information on this rapidly evolving technique? Do it today, because you may be able to put that information to work tomorrow morning.

Are you planning to put in some time next week studying industry standards as part of the work your chapter standards committee is doing? Do it today, because industry is eagerly awaiting new and more up-to-date standards.

Are you planning to give some of your associates a pat on the back for a job well done? Do it today, because you may forget to do it tomorrow. Your fellow workers will remember today's compliment tomorrow and try to do an even better job.

Industry's future, ASTME's future and our own professional future depend on what kind of a job we do today. Success is built on solid accomplishment. There is no payoff on promises to do something tomorrow.

What was the future yesterday is the present today. The future is now and now is the time to get the job done.

W. Moreland

PRESIDENT
American Society of Tool and Manufacturing Engineers

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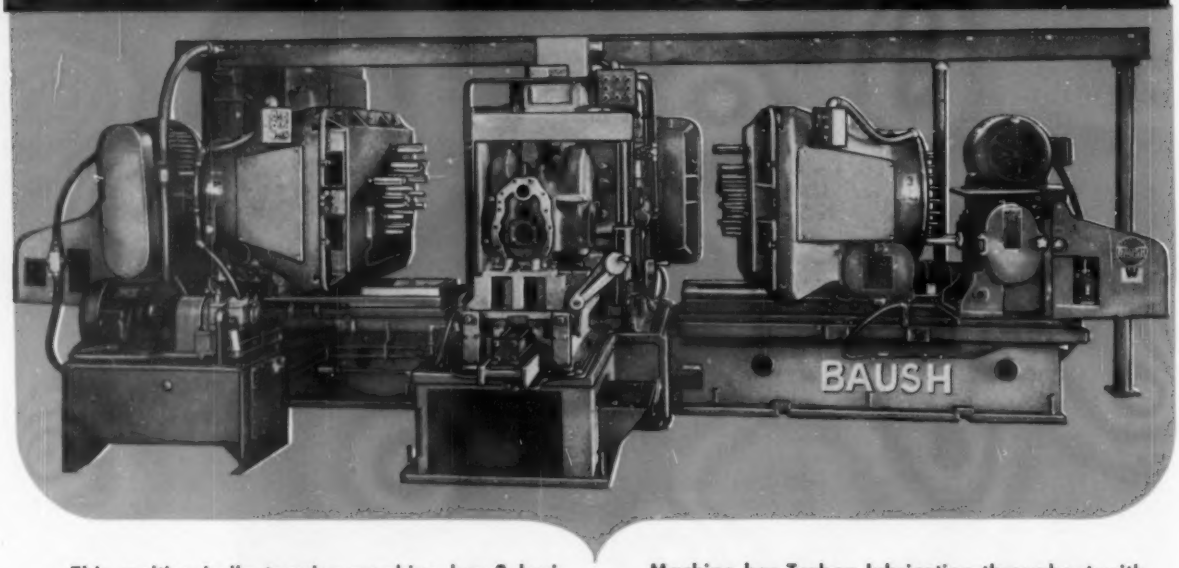
BAUSH 3-WAY "M" TYPE MECHANICAL MACHINE TAPS 78 HOLES IN SIDES and REAR OF TRANSMISSION HOUSING FOR TRACTORS



This multi-spindle tapping machine has 3 horizontal "M 25" machine sections mounted on a welded steel center base with 3—27"x50" rectangular heads.

Each head is bored and furnished with 38—2" diam. upper spindle pinions that have 2 speeds and a neutral position. The 3 master-bored cluster plates carry a total of 78 slip-sleeve spindles driven by three 25 HP, 1800 RPM motors.

A special holding fixture is designed to act as a carriage for the part and operates on hardened and ground ways. The part is set into fixture which is operated by a 5 HP, 1200 RPM motor, with three 1 HP, 900 RPM motors giving rapid traverse to the 3 heads.

Machine has Trabon lubrication throughout with Norgren lubrication for tapping. Electrical controls are to J.I.C. Standards and center base has chip conveyor.

In this installation the unit is used as a tapping machine only, on heavy tractor transmissions, but it can be readily adapted to drilling as well.

Why not let Baush Engineers build YOUR special machines — their experience of more than 60 years will pay you dividends in smooth, fast, competitive production.

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SPRINGFIELD 7, MASSACHUSETTS

TRAINING MANUFACTURING ENGINEERS

in-plant program pays off

By T. W. Black
Senior Associate Editor

When a company hires engineering graduates, it wants to make them as productive as possible as fast as possible. Here's how one company is training its neophyte manufacturing engineers so that they can take on responsible engineering assignments quickly.

WHEN AN ENGINEER receives his degree and goes to work in industry, his education has just started. Before he can be a truly effective manufacturing engineer, he needs to learn a great deal about his company's manufacturing operations and about its products. And, since modern manufacturing is a team effort, involving just about every department in a company, he needs to know what all departments do—and why they do what they do.

A manufacturing engineer who is designing a production line for a new type of product, for example, will probably work with product design engineers, specialists in tool design, machine processing, material handling and the like, quality control experts, production control personnel, cost accountants, purchasing people and, ultimately, tool and die makers and workers on the production floor. At almost every step, he'll be dealing with top company management too, and he'll have to take into account his company's broad objectives and long-range

TALK WITH THE BOSS. Manufacturing engineering trainee William Holliday gets a briefing from Warner Electric Brake & Clutch Co. operations vice president Edward A. Cleary. Trainee Holliday graduated from Michigan State University in 1958, has already completed 8 months of the 23½-month program.

THINK IT'LL WORK? Trainee Bill Holliday looks on as Warner Electric's Lee Ruffner, manager of engineering and research, goes over the details of a new packaged clutch-brake drive at a product planning session. Manufacturing engineering trainees spend several months working with product engineers.

plans during his initial planning.

Most companies recognize that neophyte manufacturing engineers are more effective if they have broad training within the company, but they expect their engineers to gain this training on an informal basis. While engineers ultimately pick up information about their companies in this way, it may be five or ten years before they have a good understanding of over-all operations. And there may be serious gaps in that understanding.

With this in mind, Warner Electric Brake & Clutch Co., Beloit, Wis. manufacturer of electromechanical drive and control devices, has developed a 23½-month in-plant training program for manufacturing engineers. As a small company (600 employees, $12 million annual sales), Warner Electric wants to make its manufacturing engineers as productive as possible as fast as possible. According to Edward A. Cleary, Warner Electric operations vice president and the man who initiated and developed the training program, the company simply can't afford half-trained manufacturing engineers. About eight percent of the employees are graduate engineers and the company depends on its engineers for success in a competitive field. Further, Warner Electric is continually introducing new products and, as a result of its diversification program, has more than doubled its business during the past 10 years. Continued diversification and expansion would be impossible without well-trained engineers.

The training program was started several years ago on a tentative, experimental basis. Results have been so satisfactory that the program has now been firmed up and placed on a formal basis. About a dozen manufacturing engineers have been through various phases of training so far and Warner Electric plans to graduate at least two manufacturing engineers from the formal program every year.

All trainees are graduate engineers—usually in the mechanical, electrical or industrial fields. They are selected on the basis of their interest in the program, the results of a series of tests that are given to all Warner Electric engineers before they are hired and on the basis of personal evaluation by company management. The company prefers engineers who are fresh from college or who have at the most six to twelve months of industrial experience in other companies. Warner Electric executives feel that an individual who has more experience may be too set in his ways—have too much to unlearn—to make a good manufacturing engineering trainee.

Manufacturing Comes First: The trainee spends the first six months of the 23½-month program in the manufacturing engineering department. Here he works with process engineers, work standards engineers, tool engineers and machine process

engineers. He is not expected to become an expert in any one of these specialized fields at this time. His job is to become generally familiar with all aspects of the work done by people in the department.

Warner Electric manufacturing operations cover a broad range of methods and processes—stamping, machining, welding, precision assembly. Production runs are not long—they range from 2000 parts to 20,000 parts on the average—which means that tooling must be kept simple and versatile. There is no automation as such. Most production is accomplished with standard machines, grouped for in-line production and connected by conveyor systems. Typical machining tolerances are ± 0.005 inch on parts 5 inches in diameter—fairly tight tolerances by most standards. Product reliability requirements are extremely high. All of this places a premium on sound—yet imaginative—manufacturing engineers.

It also places a premium on keeping facilities up to date. Warner Electric's policy is to modernize its manufacturing facilities on a consistent basis. Ultimately, every machine in the plant will be replaced every five or six years. Thus the attitude of company manufacturing engineers could be described as progressive. They're looking for new ideas—an attitude that is soon acquired by trainees.

During his first eight weeks in manufacturing engineering, the trainee works with process engineers. This gives him a good over-all knowledge of production planning. As part of this training, he participates in meetings where future products of the company are analyzed long before detailed production planning starts. Research engineers, product design engineers and manufacturing engineers get together to talk tooling, finishes, tolerances at a time when design changes can be made with an eraser. The objective is to avoid "designing in" product features that can result in unduly high production costs.

The trainee also observes pilot runs of new products to see how a new manufacturing line functions when "hard" tooling is tried out for the first time under production conditions. Here he has a chance to see how effective process planning has been and he gets a taste of actual processing problems. Trouble shooting and methods improvement on existing operations are other aspects of his process engineering training.

During the next four weeks, the trainee learns the fundamentals of work measurement and the use of time studies for different types of operations. Also, he spends a considerable amount of time actually observing operations on the production floor—experience that familiarizes him with production operations. He does not actually take time studies but he does learn how to use a stop watch and how to rate worker performance.

Production workers at Warner Electric are paid under an incentive system—the greater a worker's productivity, the greater his pay. Administration of this plan is not a function of the manufacturing engineer, but he does need to understand it fully because of its effect on manufacturing costs. The trainee studies the appropriate provisions in the Company-Union contract. Experts discuss the incentive plan with him and show him how it works. Once the trainee has a reasonably good understanding of work standards and incentives, he works with cost estimators, who show him how what he has learned applies to manufacturing planning.

The trainee's next assignment is to work for a month with tool engineers. There he finds out how tool requirements for a new product are determined and how tooling costs are estimated. He learns how requests for project appropriations are initiated and how new tooling is procured. He participates in the inspection and tryout of new tooling and is taught the fundamentals of tool trouble shooting and maintenance. He also works with tool and die designers. Unless a trainee has an apprentice background or previous experience he will not be asked to design tools during the training period; however, he is expected to learn what performance can be obtained from various types of tools, how to "move metal around" and what product tolerances are realistic from a tooling standpoint.

After his exposure to tool engineering, the trainee spends six weeks in machine processing. At Warner Electric, machine processing involves developing tool layouts, trouble shooting and tool control. Again, the trainee is not expected to become an expert in this field, but after his six weeks' training period he has a real appreciation of the capabilities of the machines used in the plant and he knows what to look for where machine and tool performance is involved. He has the know-how.

THIS IS HOW WE DO IT. As Trainee Bill Holliday looks on, Warner Electric time study engineer Elmer Kind takes a time study of a welding operation on an automotive trailer brake magnet. This gives Holliday a taste of production operations and acquaints him with the principles of work measurement.

IT TAKES GOOD TOOLING. Warner Electric tool engineer Robert Badger reviews the tooling for the company's new automotive air-conditioning compressor clutch with Trainee Bill Holliday. Working with tool engineers, Holliday learns design fundamentals.

Getting to Know the Product: Following his stint in manufacturing engineering, the trainee spends the remainder of the training period in other company departments. His first stop is in product engineering, where he spends 10 weeks. His first week is spent learning about all company products. Key engineers discuss product development and the design criteria for new products with him. Field applications are also stressed.

The following week is spent with Warner Electric liaison engineers. These engineers are familiar with both manufacturing engineering and product engineering and they serve as a link between the two company activities—interpreting each activity's needs to the other.

Warner Electric product design engineers work in two fields—the design of automotive products and the design of general industrial products. The trainee spends a week with each group. He starts by reviewing in-design industrial products with the senior project engineer. Then he spends at least eight hours with each other project engineer, reviewing design projects that are under way, design methods and customer problems.

The trainee's week with industrial products designers is followed by a week spent in the industrial products laboratory. There he is introduced to the types of test equipment used and the purposes of testing, and he actively participates in setting up at least one test. He must also analyze the test results.

Next the trainee spends a week with automotive designers and a week in the automotive products test laboratory. This training is along the same lines as his training with industrial products engineering—he learns by seeing and doing.

In his remaining four weeks of training in product engineering, the trainee covers a great deal of ground. He spends a week with control designers, which includes a day or two in the control laboratory; then he studies drafting practices and general design for a week. During this period he becomes familiar with drawing standards, engineering release and change procedures, engineering records, catalogs, and even blueprint filing and distribution.

The trainee's next-to-last week with engineering is devoted to observing actual applications of Warner Electric's products in its own and customer plants. His final week is spent in the Warner research department, where he becomes familiar with the type of projects that are carried out and the facilities available.

Because of his experience in product engineering, the trainee should be a better manufacturing engineer. The company's products will no longer be just a series of part and assembly numbers. He will appreciate the need for meeting tolerances and, to a degree at least, he will speak the product designer's language. Better communications result.

The Industrial Relations Viewpoint: At first thought, industrial relations does not seem directly related to manufacturing engineering. Nevertheless, Warner Electric management feels that the time the trainee spends with the industrial relations department is highly profitable. He studies the Company-Union contract, for example, with particular emphasis on grievance procedures, because grievances can arise because of changes in manufacturing methods, working conditions, work standards and the like. The trainee also reviews personnel selection techniques and policies, finds out how salaries are administered and learns safety regulations.

The net effect of the trainee's industrial relations work is to make him more conscious of the human factors involved in manufacturing. This is important because decisions made solely on the basis of engineering considerations do not always work out. Production workers' needs, desires and feelings—and their health and safety—must be taken into account when production lines are designed. If these factors are ignored, good employee relations are lost and productivity suffers.

The Quest for Quality: After a week-long stay in the purchasing department, where he is exposed to buying techniques, invoice processing, and receiving and trucking operations, the trainee starts a 14-week period of familiarization with Warner Electric quality control activities. By this time, his work in manufacturing and design engineering has made him aware of the need for quality.

Reliability requirements for clutches and brakes are high, of course, and the company subjects all completed products to functional checks. Indi-

I'VE GOT A SYSTEM. Systems analyst James Resler demonstrates an IBM 402 accounting machine to manufacturing engineering trainee Bill Holliday as Robert Grumley, manager of general accounting, and David W. Allen, manager of systems and procedures, look on. Production scheduling and inventory control are mechanized at Warner Electric. Trainee Holliday learns all about mechanized control systems during the period he spends with the accounting and production control activities.

vidual components are checked 100 percent at the start of production runs and when quality appears to be stabilized at desired levels, statistical control quality methods are used. Trend charts are checked frequently and when a downward quality trend is observed, the operation is stopped at once.

The trainee covers all these aspects of quality control, from the design or procurement of gages, through gage control and inspection, to actual production-line inspection procedures. He investigates the reasons for parts being scrapped and the possibilities of rework. And he finds out the causes for customer complaints. All of this gives him an invaluable insight into quality problems—an insight that should make him a better manufacturing engineer throughout his career.

Getting Down to Dollars: At this point, the trainee has reached the half-way point in the program. He is familiar with Warner Electric's products and how they are made and he is quality-conscious and cost-conscious. His next four weeks of training cover the company's financial structure. He becomes familiar with the organization and functions of the Warner accounting department, learning all aspects of the Warner standard cost system. He is exposed to cost analysis, and gets acquainted with accounting systems and procedures.

The purpose of this phase of training is to give the trainee a look at Warner Electric as a business—a business that, like any other, must pay its own way and earn a profit. The need for well-planned budgets is emphasized. Accounting systems and procedures seem dull to most engineers and the company does not expect its manufacturing engineers to ever acquire much fondness for paper work. Nevertheless, after his training in the accounting department, a trainee will have an understanding of why certain types of paper work are necessary. In the future, when he prepares budgets and submits cost estimates, he'll do his best to submit accurate, realistic information. He'll know why it's needed.

Getting Down to Business: Once the trainee has completed the financial phase of the training program, he starts a three-month period of work in production control. Here he learns how Warner Electric develops its production schedules and he becomes familiar with how—and how many—parts and assemblies are ordered to fill sales forecasts. He observes packing and shipping operations as well and does follow-up work. This, too, broadens his understanding of company operations.

Day-by-day production operations are the meat of the next three months of the program, during which the trainee works with each of Warner Electric's line supervisors in turn. This gives him a view of actual production problems and experience in supervision.

During the final three months of training, the trainee spends his time with the works manager. The purpose of this phase of his training is to acquaint him with top-level over-all planning as well as day-to-day problems. The works manager gives him specific assignments that help him develop his analytical ability and enable him to use what he's learned up to this time.

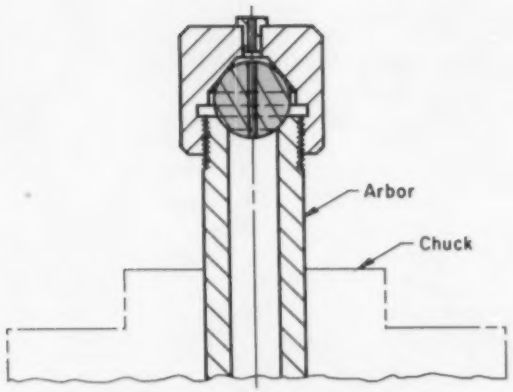
When a trainee has graduated, he usually has a good idea of the specific type of work that he'd like to do in manufacturing engineering. He has a well-rounded knowledge of all company activities. During the course of his training, he has worked with over 100 engineers and supervisors in different company departments—contacts that may be helpful in the future.

Management has had an opportunity to find out the trainee's interests and makes every effort to place the trainee where he'll fit in best. Whatever his assignment, he should be able to take on responsible duties at once as a result of his in-plant training.

Because the program is new, Warner Electric's management has no comparative data on the job performance of engineers who have been through the program and those who haven't. Nevertheless, top executives are counting on a long-term payoff on their short-term investment in training of manufacturing engineers. And that payoff starts as soon as the trainee gets his first manufacturing engineering assignment. He's a better engineer.

Gadgets

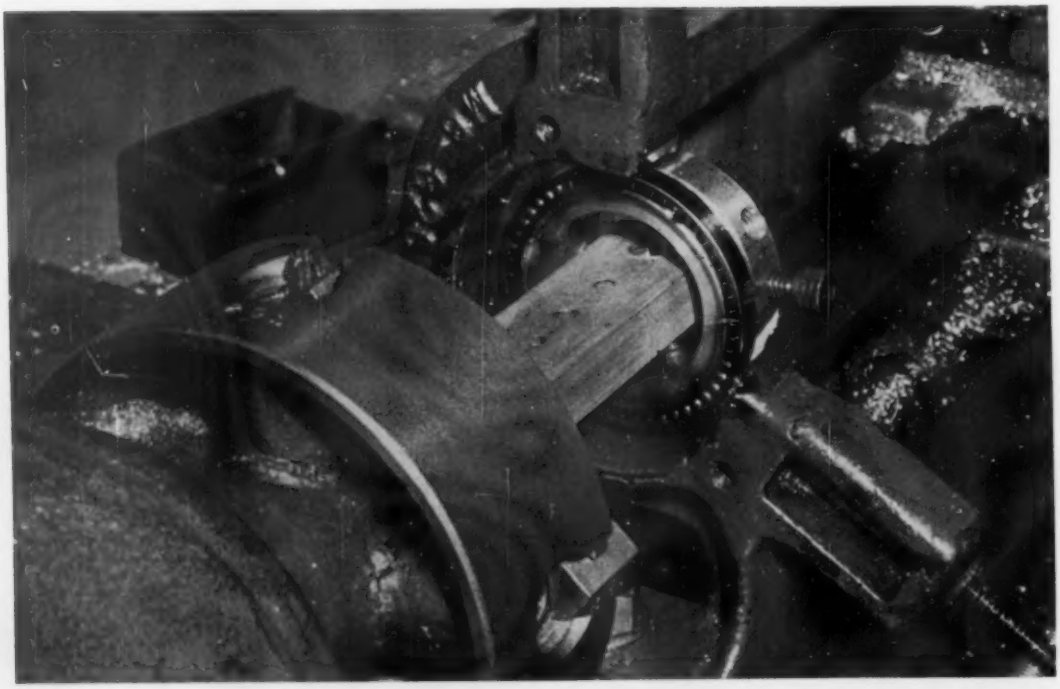
Ingenious Devices And Ideas



Fixture Centers Steel Ball for Drilling

Steel balls can be locked in position for through-hole drilling with the fixture illustrated. Three components—an arbor, locknut and drill bushing—are the only parts required. Both the arbor and the locknut are countersunk at a 45-deg angle to place the ball on center. Design of the fixture allows it to be used on either a lathe or drill press.

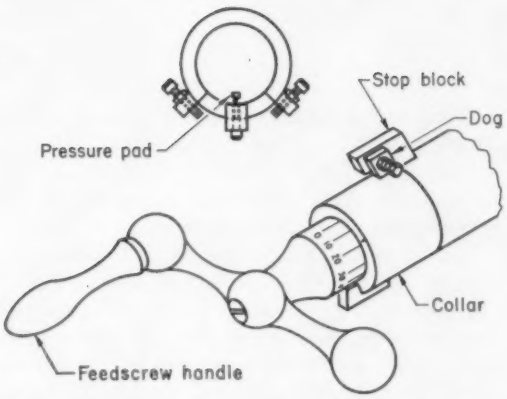
Roger Isetts
Kenosha, Wis.



Steadyrest Supports Multisided Work

Square, rectangular and hexagonal parts can be supported in steadyrests during turning operations with adapters of this design. Machined to fit the inside diameter of a ball-bearing race, the adapter is held in position by the pressure of the steadyrest clamps on the race. Socket-head capscrews screwed through the collar enable the lathe operator to adjust and maintain the workpiece at dead center.

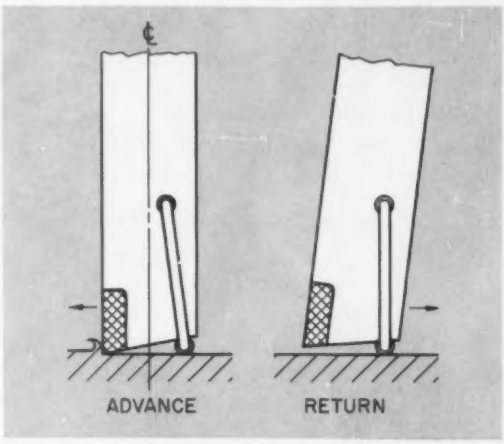
C. Gibbons
R.C.A.F. Station
Greenwood, N. S.



Collar Eliminates Backlash Error

Because of backlash, accurate readings are often difficult to obtain when feedscrews are reversed. The device illustrated eliminates error introduced by backlash through use of a collar that provides a rotating witness line. As the direction of feed is reversed, the collar rotates through an arc equivalent to the backlash, thus preserving the reading on the graduated handle. Refinements on the degree of arc through which the collar rotates are provided by a screw adjustment on dogs that contact a positive stop block.

Clint McLaughlin
Rockaway, N. Y.



Roller Attachment Elevates Carbide Tools

When tungsten carbide tools are used in planing and shaping operations, it is essential that they be lifted free of the workpiece on the return stroke. Modern machines have electrical or mechanical tool lifts but older, precarbide machines do not. This gadget is designed to make carbide tools practical for older machines by providing them with an automatic elevating device for the return stroke.

Thomas A. Faulks
Sheffield, England

Don't Forget Your Gadgets Contest Entry

The 1961 Gadgets Contest is underway. It provides you with an opportunity to win a prize while showing off that pet gadget idea of yours.

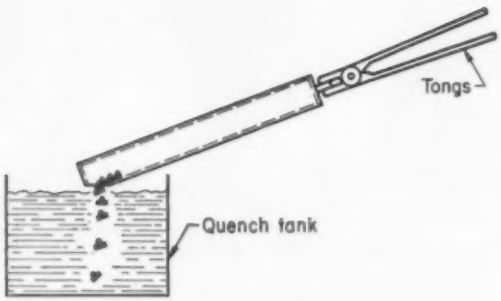
Entering the Contest is simple. Just send in a drawing and a brief description of your idea, telling us what it is, what it does and how it works. Don't worry about the quality of your drawing or the gloss on your literary style. We'll take care of the details. These are the simple rules:

- **Contest is open to ASTME members only.**
- **Entries must be limited to 500 words.**
- **Sketches in lieu of finished drawings are acceptable.**
- **Entries will be judged by the Editorial Committee on the basis of originality, conciseness and clearness of presentation.**
- **Prizes: First prize of $100; two second prizes of $50; four third prizes of $25; and awards to all close runners-up.**
- **Contest closes Dec. 31.**

Send your entry to The Gadgets Editor, 10700 Puritan Ave., Detroit 38, Mich.

Gadgets

Parts Handler Simplifies Heat Treatment



Designed for the heat treatment of small hard-to handle parts, this gadget eliminates prolonged exposure to air during transfer from furnace to quench tank. This in turn eliminates cracks and excessive decarburization of the parts.

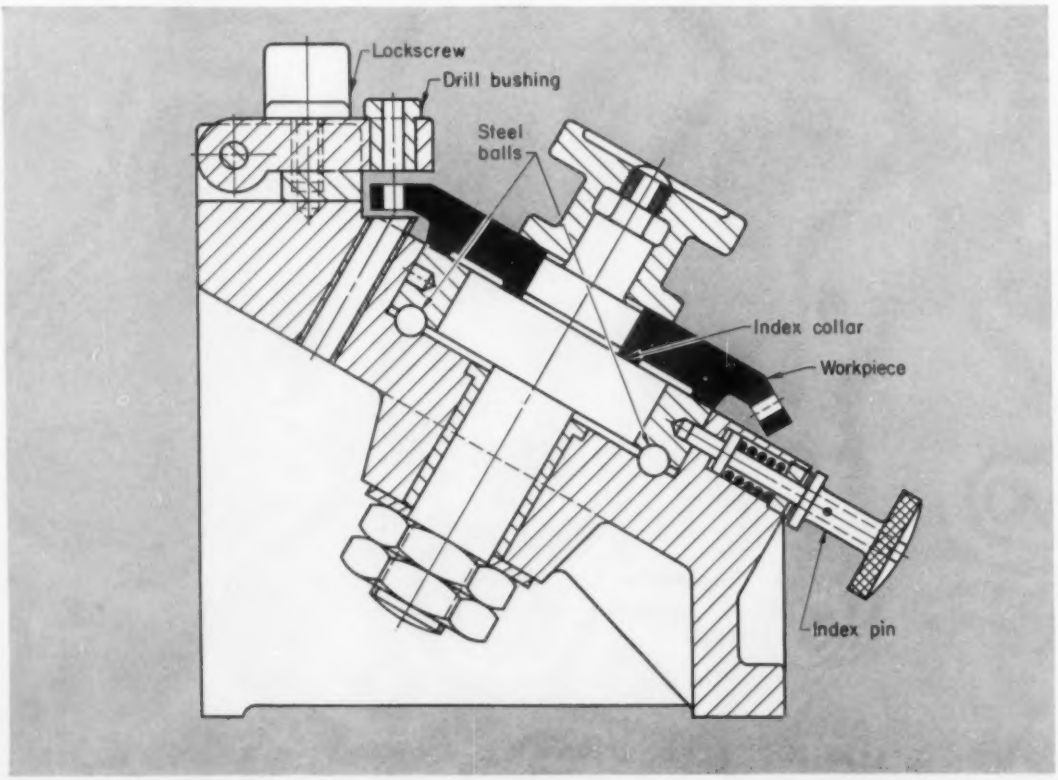
Construction of the parts handler is simple, involving only a pipe in which both ends are welded shut. The corner of one end is sawed off to permit loading and unloading, and the other has a small nib attached for handling with tongs. In use, the entire unit is loaded into the furnace for part heat treatment.

Amos L. Shellum
Minneapolis Chapter

Steel Balls Increase Indexing Speed

Rapid indexing is made possible in this fixture through the use of steel balls. This is accomplished by machining opposed radial grooves in the fixture base and in the indexing collar. Steel balls inserted in the grooves enable the assembly to turn with the facility of a bearing race. Exact positioning of the workpiece at the drilling station is accomplished with an index pin that engages one of 12 equally spaced holes on the circumference of the index collar.

Hjalmar Dahl
Upplands Vasby, Sweden



don't reject those GOOD PARTS

Acceptance gages reject an increasing number of good parts. Five methods are offered to reduce this unnecessary waste and reduce cost of manufacture.

By Edward S. Roth
Advanced Manufacturing, Development Div.
Sandia Corp.
Albuquerque, N. M.

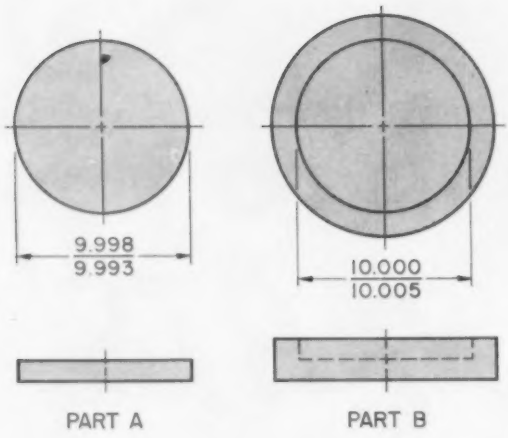
FINAL ACCEPTANCE GAGES always cause the rejection of some parts which would fit perfectly in assembly. Older machines make parts with considerable size variation, and the rate of unnecessary rejects is low, constituting the price manufacturing is willing to pay for assembly reliability. Recent and more precise machine tools, however, have narrowed the range of size variations in machined parts, and the rate of unnecessary rejects has increased correspondingly. Gaging techniques have not kept pace with the increased accuracy of the machine tools.

Theoretically, gages should only reject all out-of-tolerance parts. In practice, many in-tolerance parts are also rejected, as some of the part tolerance is taken up in the gage tolerance and wear allowance. This effectively reduces the designed part tolerance by some 15 percent, of which 10 percent is gage tolerance and 5 percent gage wear allowance. And, as the parts must usually fit freely in a receiver-type gage, this fit requirement further increases the number of in-tolerance parts rejected.

As an illustrative example, Parts A and B in *Fig.* 1 are designed to fit into each other with a minimum fit allowance of 0.002 inch. Current design practice of receiver gages for these parts is shown in *Fig.* 2, where the gages take up to 10 percent of the 0.005-inch part tolerance as their tolerance. This is assumed to include wear allowance.

The assembly relationship of Part A and Gage 1, and Part B and Gage 2, are shown in TABLES 1 and 2 respectively. Some of the parts will be rejected, as the inspector normally rejects any part that has to be forced into or out of a gage.

When Part A is 9.998 inches and Part B is 10.000 inches, they should fit together—providing the fit allowance is appropriate—yet both parts will be rejected by the inspector as there could be interference between part and gage. Even when Part A is 9.997 inches and Part B is 10.001 inches, with actually twice the fit allowance initially specified, the inspector could reject each part because it might have to be forced into its respective gage.



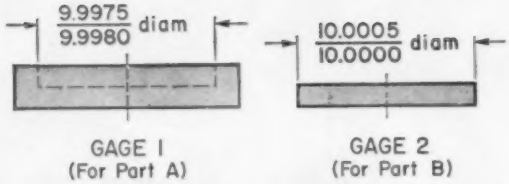


Fig. 2. (above) Current practice of gage design would produce these gages.

Fig. 1. (left) Part A is designed to fit in Part B with a minimum fit allowance of 0.002 inch.

Table 1—Parts Checked with Gage 1
(Gage diameter and tolerance = 9.9975/9.9980)

Part Diameter (inch)	Gage-to-Part Allowance (inch)	Acceptability to Gage Operator
9.9980	0.0000-0.0005	Not acceptable
9.9970	0.0005-0.001	Not acceptable*
9.9960	0.0015-0.002	Possibly acceptable
9.9950	0.0025-0.003	Probably acceptable
9.9940	0.0035-0.004	Acceptable
9.9930	0.0045-0.005	Acceptable

*This part should always be accepted if gage takes only 10 percent of part tolerance.

Table 2—Parts Checked with Gage 2
(Gage diameter and tolerance = 10.0005/10.0000)

Part Diameter (inch)	Gage-to-Part Allowance (inch)	Acceptability to Gage Operator
10.0000	0.0000-0.0005	Not acceptable
10.0010	0.0005-0.001	Not acceptable*
10.0020	0.0015-0.002	Possibly acceptable
10.0030	0.0025-0.003	Probably acceptable
10.0040	0.0035-0.004	Acceptable
10.0050	0.0045-0.005	Acceptable

*This part should always be accepted if gage takes only 10 percent of part tolerance.

TABLES 1 and 2 indicate that even nominal size parts (9.9955 and 10.0025) have a rejection probability. A number of ways to solve this problem exist:

Solution 1: Increase the part size tolerance so that more parts will fit in the gage even though the gage tolerance will increase. If Part A had a size tolerance of 9.998/9.988, nominal parts (9.993 diam) would fit a 9.998/9.997 gage. (*Fig.* 3a)

Solution 2: Reduce the fit allowance to zero or specify a slight interference fit. As each gage requires a fit allowance, any two parts that passed their respective gages should fit together with twice the fit allowance required. This solution automatically increases the size tolerance if the least critical size limits (9.993 and 10.005) are not changed. (*Fig.* 3b)

Solution 3: The product designer may specify the gage allowance on the product drawing. The gage designer will make the gage the size specified and then take up to 15 percent of the part tolerance as the gage tolerance in the usual way. (*Fig.* 3c)

Solution 4: Use the bilateral (split-tolerance) system and apply the gage tolerance equally from nominal. (*Fig.* 3d)

Table 3—Suggested Gage Fit Allowances and Gage Tolerances

Gage Diam. D (inch)		Part Tolerance (inch) 0.001-0.005	0.006-0.010	0.011-0.015	0.016-0.020	Over 0.020
$0<D\leq1$	Allowance	0.0000	0.0000	0.0002	0.0002	0.0005
	Tolerance	0.0002	0.0002	0.0003	0.0003	0.0005
$1<D\leq2$	Allowance	0.0000	0.0002	0.0002	0.0005	0.0005
	Tolerance	0.0002	0.0003	0.0003	0.0005	0.0005
$2<D\leq4$	Allowance	0.0002	0.0002	0.0005	0.0005	0.001
	Tolerance	0.0003	0.0003	0.0005	0.0005	0.001
$4<D\leq8$	Allowance	0.0002	0.0005	0.001	0.001	0.001
	Tolerance	0.0003	0.0005	0.001	0.001	0.002
$8<D\leq16$	Allowance	0.0005	0.001	0.001	0.001	0.002
	Tolerance	0.0005	0.001	0.002	0.002	0.002
$16<D\leq32$	Allowance	0.001	0.001	0.002	0.002	0.002
	Tolerance	0.001	0.002	0.002	0.002	0.003
$32<D\leq64$	Allowance	0.002	0.002	0.002	0.003	0.003
	Tolerance	0.002	0.002	0.003	0.003	0.004

Compiled by H. L. Durflinger, Tool Design Engineer, Sandia Corp.

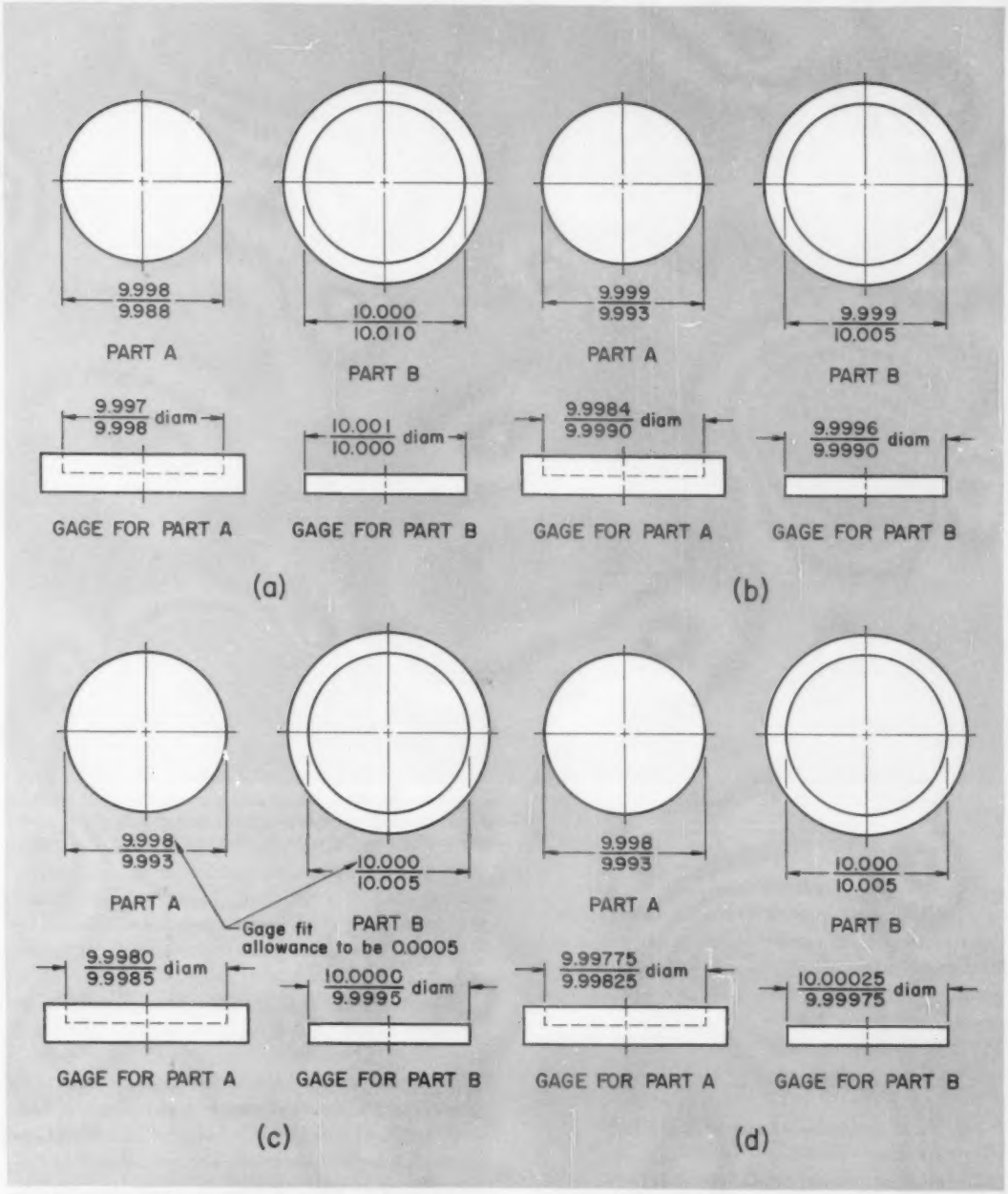


Fig. 3. Four methods for reducing unnecessary rejections. (a) Increase part tolerances so gages will accept more parts. (b) Reduce nominal fit allowance. (c) Specify gage allowance on product drawing. (d) Specify bilateral, or split tolerance gages. A fifth solution is shown in Table 3.

Solution 5: Standardize a table of gage tolerances and fit allowances to be used by both product and gage designers. A tentative standard is given in TABLE 3. Values listed there should facilitate mating of product and gage and are presented as a basis for decision marking. It may be necessary to depart from them to minimize the probability of accepting bad product. Such departures should be specified according to the method in Solution 3.

Basic inspection policy should be to accept—not to reject—all possible in-tolerance products. As a final acceptance gage should be like the mating part at its most critical dimensions, the designer must consider gage design concurrently with product design. *Solution 3* gives the designer direct control of end product quality because the sole acceptance criterion is specified direct on the product drawing and the designer is forced to consider the design of the gage.

calibrate SURFACE PLATES this easy way—

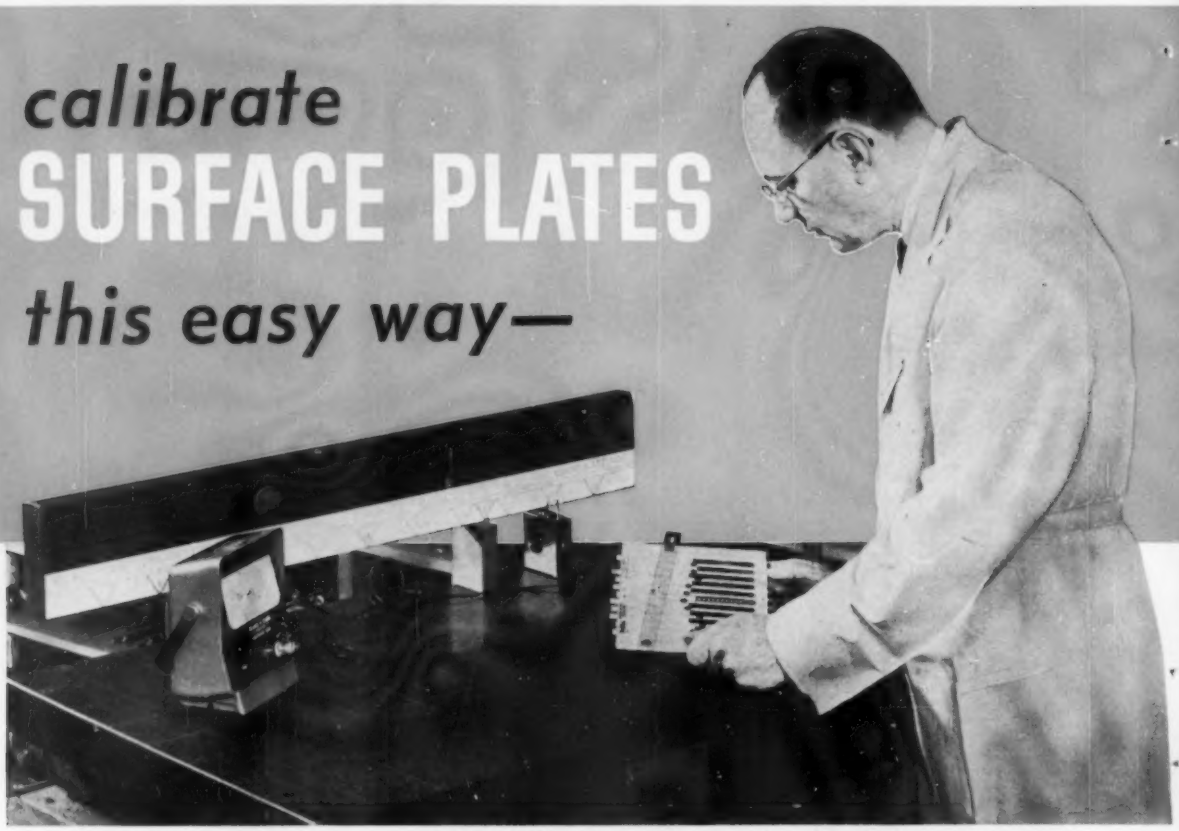


Fig. 1. The equipment shown is all that's needed to calibrate surface plates. Straightedge supports are located at points marked *S* on the straightedge; only one is visible in the illustration.

By T. N. Busch
The DoAll Co.
Des Plaines, Ill.

Traditional methods of field calibrating surface plates involve endless measurements and tediously repeated calculations which result in many possibilities for error and in lower reliability of the findings. The author has developed a new, faster and more reliable method of field calibration. In this article he explains how and why his method for calibration works.

A NEWLY DEVELOPED GRAPHICAL METHOD permits fast and easy field calibration of surface plates, and provides a quick check on the reliability of the findings.

Assuming that a 24 x 36-inch surface plate is to be calibrated, the first step is to overlay the plate with a grid of evenly spaced horizontal and vertical lines—the coordinate grid—and with two diagonals intersecting at the plate's center and cutting its long sides at 45-deg angles, *Figs.* 1 and 2. Distance between coordinate lines is 3 inches.

If the coordinates have been identified as in *Fig.* 2, one of the diagonals intersects the coordinate grid at points that have identical *X* and *Y* readings (9, 9), (12, 12) . . ., while the sum of the coordinates of any point on the other diagonal, (27, 9), (24, 12) . . ., will always equal 36, the length of the plate's long side. For identification purposes, the first will be called the "identical" diagonal, and the second will be called the "complementary" diagonal.

With two fixed-height blocks, the straightedge is

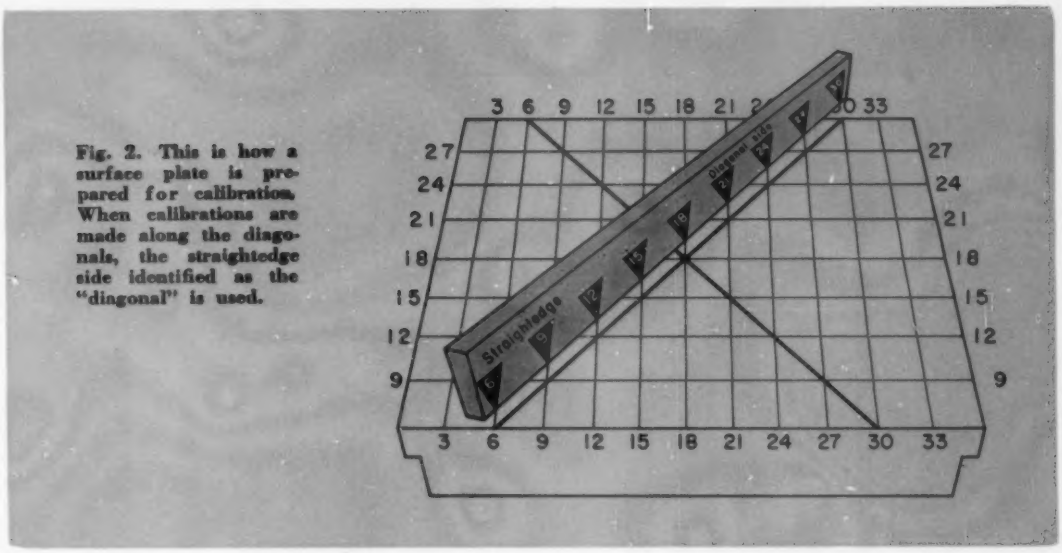


Fig. 2. This is how a surface plate is prepared for calibration. When calibrations are made along the diagonals, the straightedge side identified as the "diagonal" is used.

supported over the identical diagonal so that the straightedge station numbers match the plate coordinate numbers at all points. This standardized positioning of the straightedge, together with fixed-spot location of the supports, as shown in *Fig.* 1, assures repeatability in locating the straightedge over the diagonal. In addition, each station on the straightedge will always require the same straightedge correction.

With an instrument of appropriate accuracy, differential-height readings are made at all points where the diagonal intersects the coordinate grid. Typical measurements, together with straightedge corrections read directly on the straightedge, are shown in the accompanying table, and presented graphically in *Fig.* 3.

Greatly exaggerated by the difference in the scales, *Fig.* 3 shows, first, the actual straightedge profile as related to its theoretical line, then the differential distances measured from the actual straightedge profile to the intersects of the surface plate's diagonal, and finally a best-fit or reference line.

It is in selecting this line that the operator should exercise judgment. A line that mechanically averages all the readings is often not the most desirable and should be discarded in favor of one, like that chosen in *Fig.* 3, which goes through a number of points.

Because the straightedge profile may be assumed to remain constant, a device that gives the operator the profile of his particular straightedge without having to draw it each time can be developed. One way to achieve this would be to have graph paper overprinted with the straightedge profile, but this would be expensive and impractical. A better solution is to have a single, but reusable, graph sheet incorporating the profile of the straightedge.

Distances and Correction Factors for First Diagonal

Station Coordinates	Straightedge Station	Straightedge Correction	Gage Reading	Corrected Reading
(9, 9)	9	–20	+30	+10
(12, 12)	12	–20	+30	+10
(15, 15)	15	+10	0	+10
(18, 18)	18	+20	–50	–30
(21, 21)	21	+15	–30	–15
(24, 24)	24	+10	– 5	+ 5
(27, 27)	27	–10	– 5	–15

Called the Resolver, the device shown in *Fig.* 4 is such a sheet, on which are prerecorded both the theoretical straightedge line and the actual straightedge profile. Graduated slides replace the straightedge profile-to-surface plate lines that were drawn in *Fig.* 3, and the sharp color separation between halves of each slide gives a quick visual presentation of the profile of the plate along the "identical" diagonal line.

A best-fit line, too, can be quickly established by adjusting the reference line slide as desired over

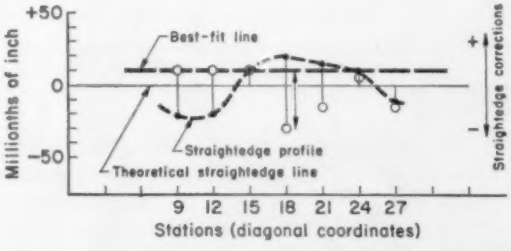


Fig. 3. Less tedious than method used in the table, this graphical representation of the findings is still time consuming. Each station corresponds to diagonal coordinates of same values.

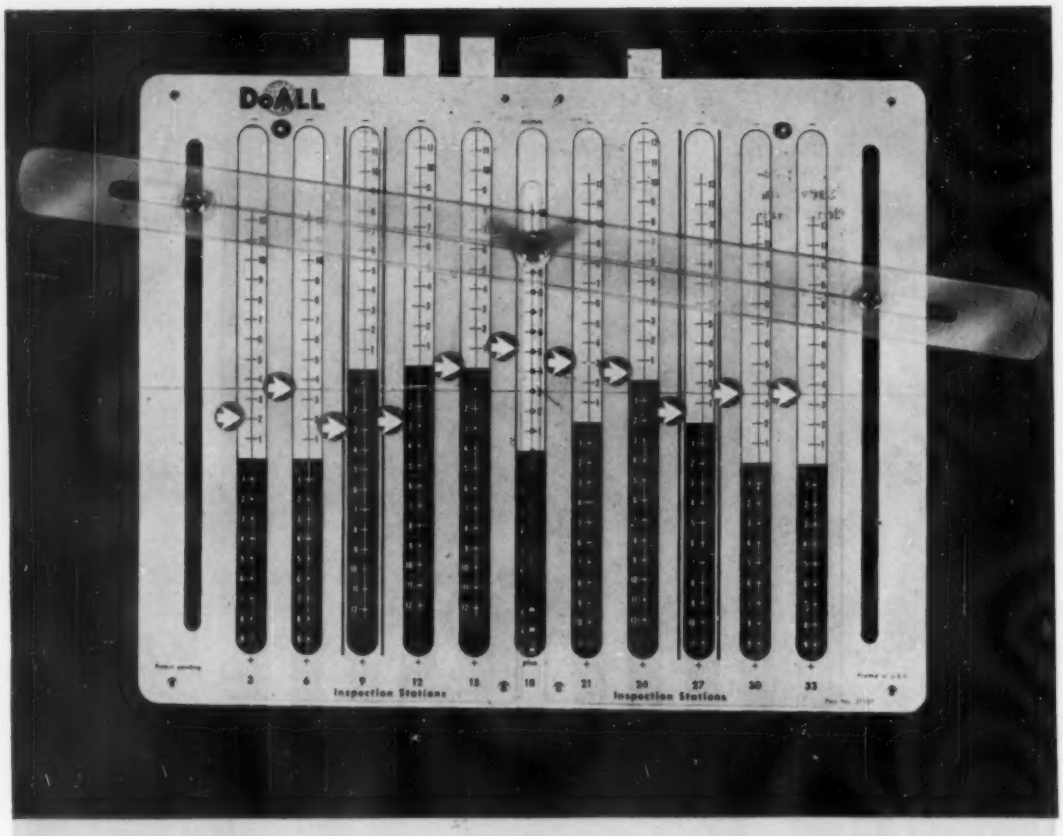


Fig. 4. Basically a re-usable graph sheet with preprinted profile of the straightedge with which it is used, this Resolver reduces all operations to moving station slides and the reference line slide.

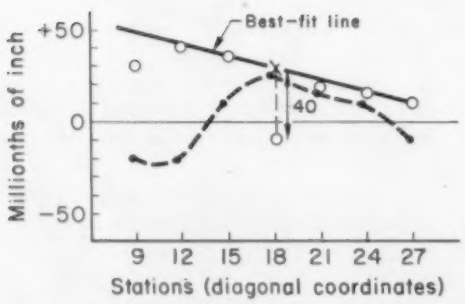


Fig. 5. Best-fit line for the second diagonal must pass through point (x), 40 millionths above the plate. Straightedge profile is unchanged.

the diagonal's profile. Distances from this best-fit, or reference, line to any station on the diagonal's profile are read directly under the reference line.

This reference line lies in the reference plane, that theoretical plane from which all distances to the surface plate are measured. Station readings under the reference line can therefore be entered directly onto the plate calibration sheet.

To define the reference plane, another line is needed, intersecting the established one. This second line is obtained from the second or complementary diagonal in a manner similar to the one used in getting the first reference line.

In selecting the first reference line the operator had two degrees of freedom: slope and intersect with the theoretical line. In the selection of the second reference line he is restricted by the fact that the point at which it intersects the first reference line is already determined. As a result, he has but one degree of freedom: slope with the theoretical line.

In practice this means that the distance between surface plate point (18, 18) and the first reference line must be the same as that between the same plate point and the second reference line. In our example, the second reference line must pass through a point 40 millionths of an inch above point (18, 18) on the plate. In a graph, *Fig.* 5, this is achieved by construction. On the Resolver the same end is achieved by locking the center pin on the reference line slide in position on slide 18 when the first

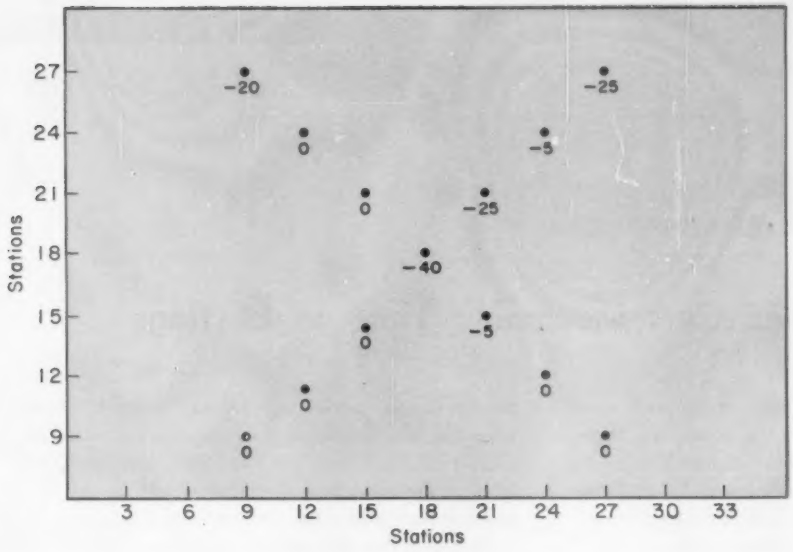


Fig. 6. Typical calibration sheet after both diagonal reference lines have been located.

Fig. 7. (below) Reference line for plate line 9-9 is fixed by its distance from points (9, 9) and (9, 27).

reference line is chosen. This sets its distance from the plate, but still allows freedom to rotate it to establish the reference line for the complementary diagonal.

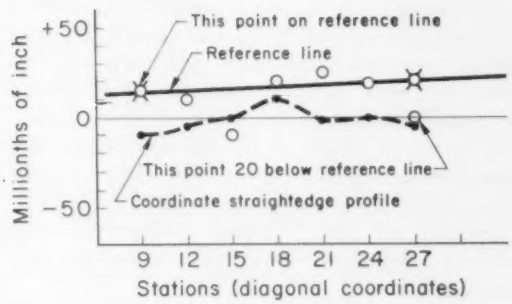
Distances between this complementary reference line and the grid intersection points under it are read in a similar manner as the first reference line, and recorded.

The calibration sheet now has the information shown in *Fig.* 6. It will be noted that each of the long (horizontal) grid lines on the reference plane is now determined by its distance from two points on the plate, with the exception of line 18, for which only one point is known. To find a second point on this line, the intersection of line 18 with a vertical line, such as vertical 9, can be found.

Because distances between consecutive stations on the vertical and horizontal grid lines are different from those on the diagonal lines, another side of the straightedge is used, its stations appropriately marked at 3-inch spacings.

A new straightedge profile now applies, which may be drawn on a graph sheet, *Fig.* 7, and is found on the other side of the Resolver. Again distances between the straightedge and the plate are measured and entered on the graph or on the Resolver. The operator has no freedom in selecting this reference line, which is determined by its distance from points (9, 9) and (9, 27) on the plate. Distances from this reference line to the grid intersections are read and the values are entered on the plate calibration sheet, *Fig.* 8.

The same operation is now repeated for each of the horizontal lines. For four of them, (lines 12, 15, 21 and 24), three points are known, the third point providing an immediate visual check of accuracy. For a more complete check, the operations



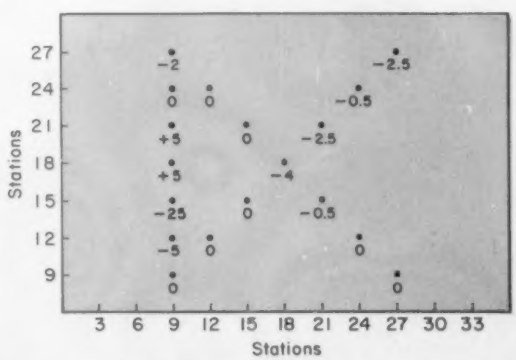


Fig. 8. Calibration sheet includes readings under one coordinate line.

are repeated on the vertical lines and these distances are compared with those obtained when measuring from the horizontal lines.

Total time required with this system is approximately one hour, as compared with six hours by the standard method. Even more important, as the operator needs to make no calculations, many possibilities for error are eliminated.

designed for

PRODUCTION

Boring Head Cuts Machining Time on Castings

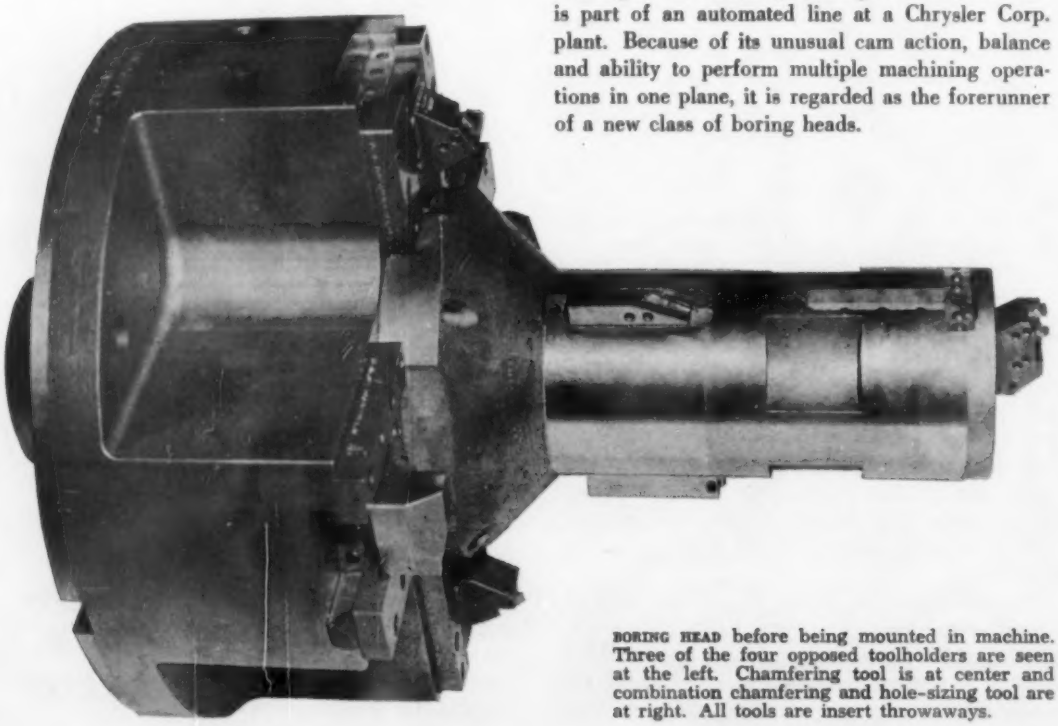
Operating at 600 rpm, this boring head completes five operations on an aluminum transmission housing in nine seconds. These include one diameter-sizing, one chamfering and three cross-facing operations. All operations are accomplished by radial movements of the cutting tools.

Minimal machining time results from the use of four cutting tools on the principal cross-facing operation. Located at 90 deg intervals on the largest section of the boring head, these tools work in pairs; two work out from the center of the workpiece and two feed in. In this way, optimum cutting speeds and feeds can be maintained while cutting time is reduced to a quarter of the amount which would normally be required.

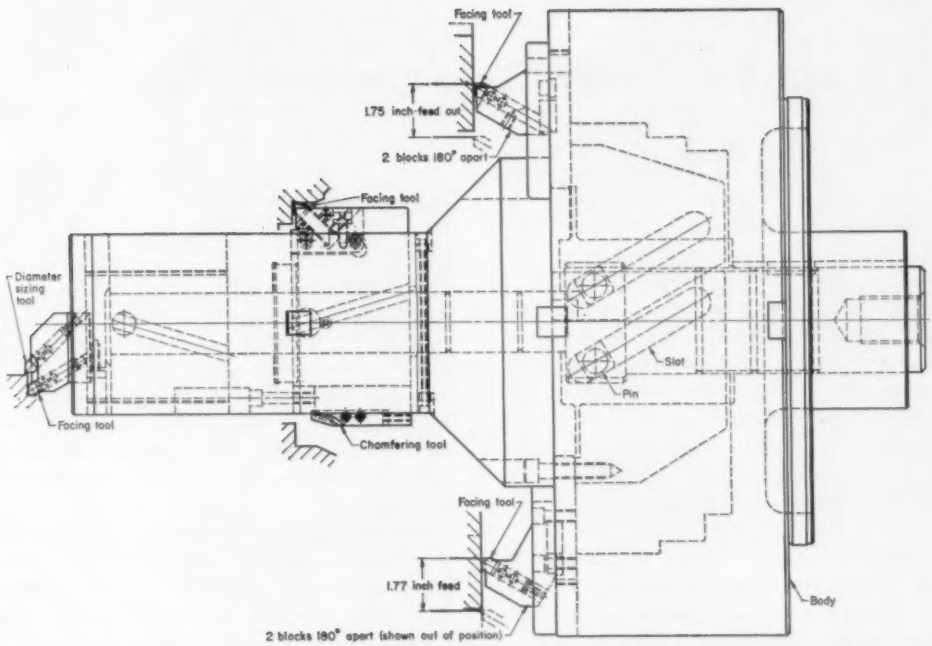
Activation of the cutting tools is effected by cam action on the slides on which the toolholders are mounted. As machining begins, a hydraulically operated bar, in which cam pins are mounted, advances in the head. The cam pins are fitted into slots in the slides and their movements in the slots are the source of toolholder movements.

The fact that the cutting tools are mounted in opposition to each other while machining in the same plane makes an exact from-centerline relationship between them mandatory. This means that the cam surfaces—pins and slots alike—must be ground to gage-block accuracy, and that cutting tools must be positioned with a height gage. In addition, an exact dimensional relationship between opposing toolholders is necessary to maintain proper balance. Should any imbalance occur as a result of improper slide advance, a vibration pattern would be established in the head.

Designed and built by Gairing Tool Co., the head is part of an automated line at a Chrysler Corp. plant. Because of its unusual cam action, balance and ability to perform multiple machining operations in one plane, it is regarded as the forerunner of a new class of boring heads.



BORING HEAD before being mounted in machine. Three of the four opposed toolholders are seen at the left. Chamfering tool is at center and combination chamfering and hole-sizing tool are at right. All tools are insert throwaways.



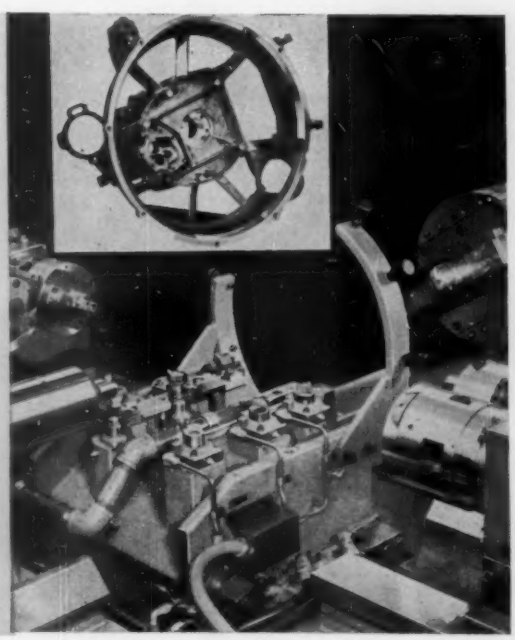
TOOLHOLDERS for the principal cross-facing operation are shown out of position in this drawing. The toolholder at the top is opposed by a similar unit at 180 deg. These are spaced at 90 deg intervals from two other units which are represented by the unit at the bottom.

Boring Fixture Has Vibration Dampener

Vibration, a recurrent problem when large and comparatively fragile castings are machined, is dampened through use of a special fixture in this Ex-Cell-O boring machine. The workpiece, shown in the insert, is a die-cast aluminum crankcase. Clamping of the workpiece on rest pads is effected hydraulically.

Dampening of vibration is accomplished with a circular bracket that surrounds the large diameter. After hydraulic clamping has been accomplished, dog-point screws in the brackets are tightened to support the part during machining.

The machining operation is initiated by pushbuttons. At the start of the operation the front and rear slides advance and finish face the cylinder mounting pads. Crankshaft bearing diameters are bored from the left side to a tolerance of 0.0003 inch. Spindles mounted on the right slide then advance and machine the large (15-inch) diameter to a tolerance of 0.003 inch.



DESIGNED FOR PRODUCTION

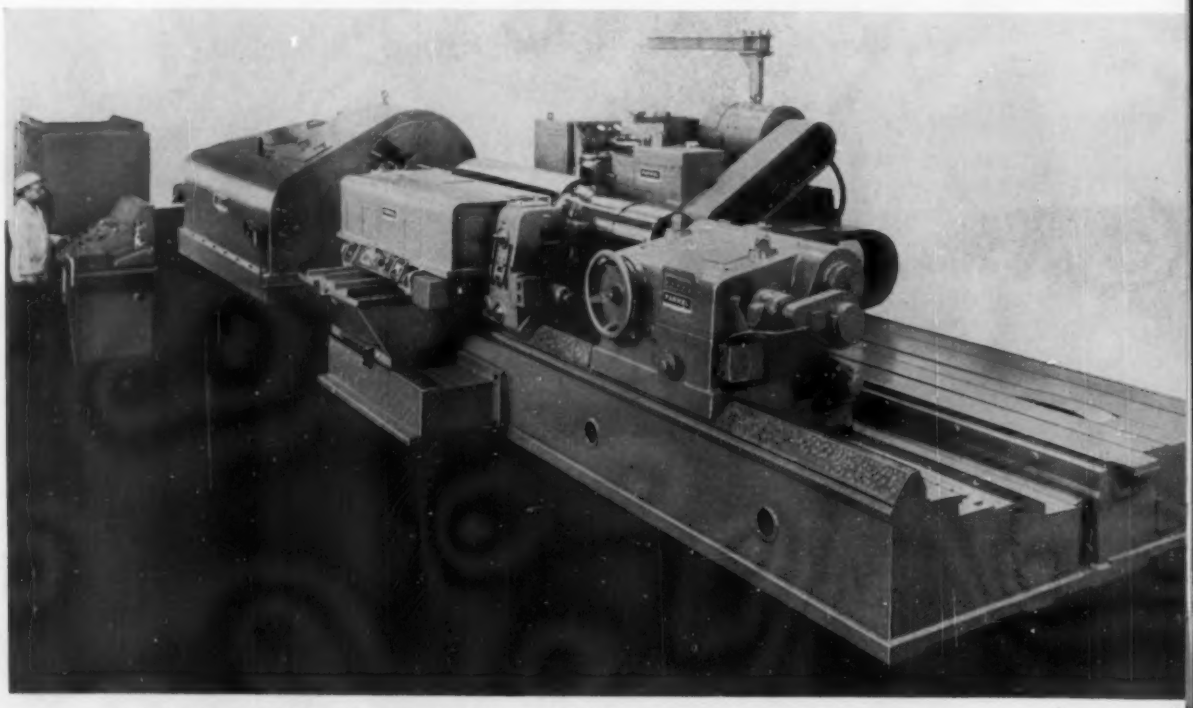
Rolls Refinished on Tape-Controlled Grinder

Numerical control and an unusual probe table are utilized in this machine to speed the grinding of rolls, some of which range up to five feet in diameter. Because the rolls are subjected to extremely large forces in the rolling of ingots and steel sheet, surface wear is excessive and regrinding after four to ten hours of service is necessary. Making the operation more difficult is the fact that the rolls are not cylindrical; the great majority of them have crowned surfaces to compensate for the distortion caused by rolling forces. Under pressure, the curvilinear roll surface—ground to tolerances of 0.001 inch—becomes straight at the line of contact with the work.

The function of numerical control in this application is to activate and control 17 discrete machine functions. These include such operations as preliminary setup for grinding, sizing of a roll to make it identical to a mating roll, wheel dressing, cycling through a roughing operation, cycling through a finishing operation and tailstock adjustment for correction of taper. Throughout these operations, tape control of the machine is maintained by continuous feedback from the probe table to the NC unit.

In operation the probe table scans the workpiece and finds the point of greatest wear. The roll dimension at this point is memorized by the control system and is used as a bench mark for rough grinding. During finish grinding, this point is barely cleaned up. Because all necessary adjustments for taper and crown have been made at this point, there is no removal of stock in excess of minimum requirements.

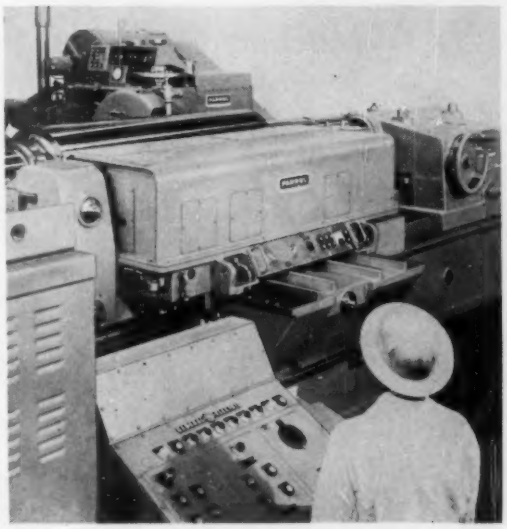
An interesting aspect of this design is the manner in which the machine changes wheel position to grind the crown. Generally, a crown surface is from 0.012 to 0.015 inch higher at the center of the roll than at the end. Generated as a sine curve, the roll profile would be virtually impossible to grind by conventional in-and-out head movements because of slip stick. This problem is overcome in



OVER-ALL VIEW of the machine. Probe table is visible on ways at the center of the machine.

this machine by rotation of the head through a small arc during crown grinding. Rotation is provided by the action of a circular off-center cam on a bearing surface at the rear of the machine. A screw adjustment enables the operator to obtain desired curvature in the crown by setting the cam to a requisite distance off center. Except during crown grinding, conventional infeed is used, however.

Built by Farrel-Birmingham, Ansonia, Conn., the machine is one of three built for Great Lakes Steel Corp. Special numerically addressed sequence and servocontrols for the grinder were developed by the General Electric Specialty Control Dept.

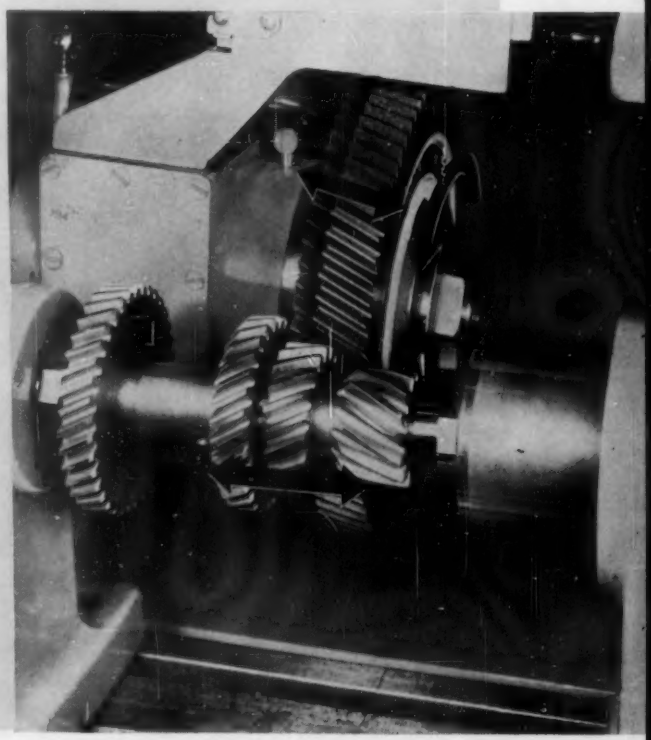


PROBE TABLE advancing to contact workpiece. Controls visible at rear are mounted on the grinding head.

Four-in-One Motion Hones Gears

Designed to remove nicks and burrs from hardened gears and cylindrical parts, this machine utilizes a combination of four motions between tool and workpiece. These motions are: in-mesh rotation under controlled load; high-speed axial oscillation of the tool in a ratio of three oscillations to one revolution of the tool; reciprocation motion which transverses the work a preset amount across the hone; and motion resulting from the crossed axis relationship between the hone and the work. On small gears the table motion is deactivated and only three of the motions are used.

Developed at Michigan Tool Co., Detroit, the machine makes use of a new type of hone for finishing the gears. Cast in the form of a gear and made of plastic impregnated with an abrasive material, the hone can be fabricated with a variety of grits—from extremely fine to coarse—for a variety of finishes. Finishing speeds of the machine are variable.

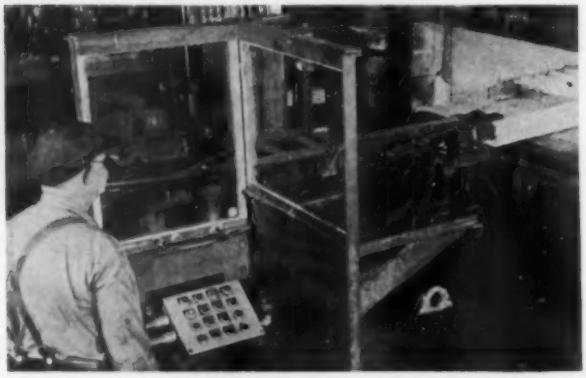


Machine Quenches, Straightens Hardened Rails

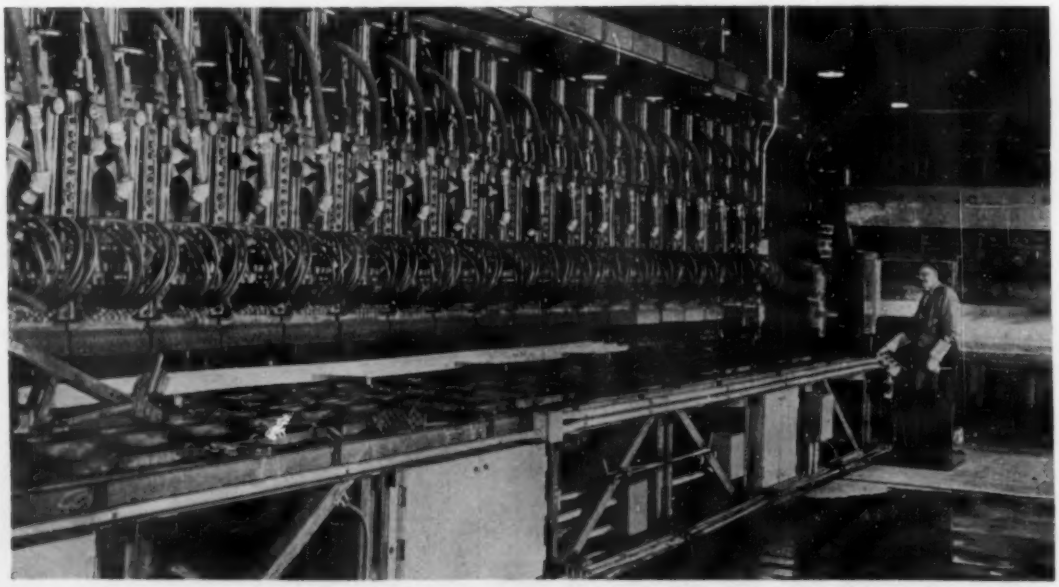
Designed to eliminate distortion resulting from heat-treat quenching, this machine can handle channel type rails up to 40 feet in length. Developed and built by A. O. Smith Corp.'s automotive group, it eliminates manual straightening operations, making heat treatment of the rails a mass-production operation. A transfer mechanism capable of handling the parts was built in conjunction with the quenching machine.

At operator command, the transfer mechanism reaches into the furnace, seizes the rail and withdraws it to a predetermined position in front of the quenching machine. It then pushes the rail into position on top of knockout rods contained in the lower portion of the machine. The rods descend and the rail is lowered into the machine.

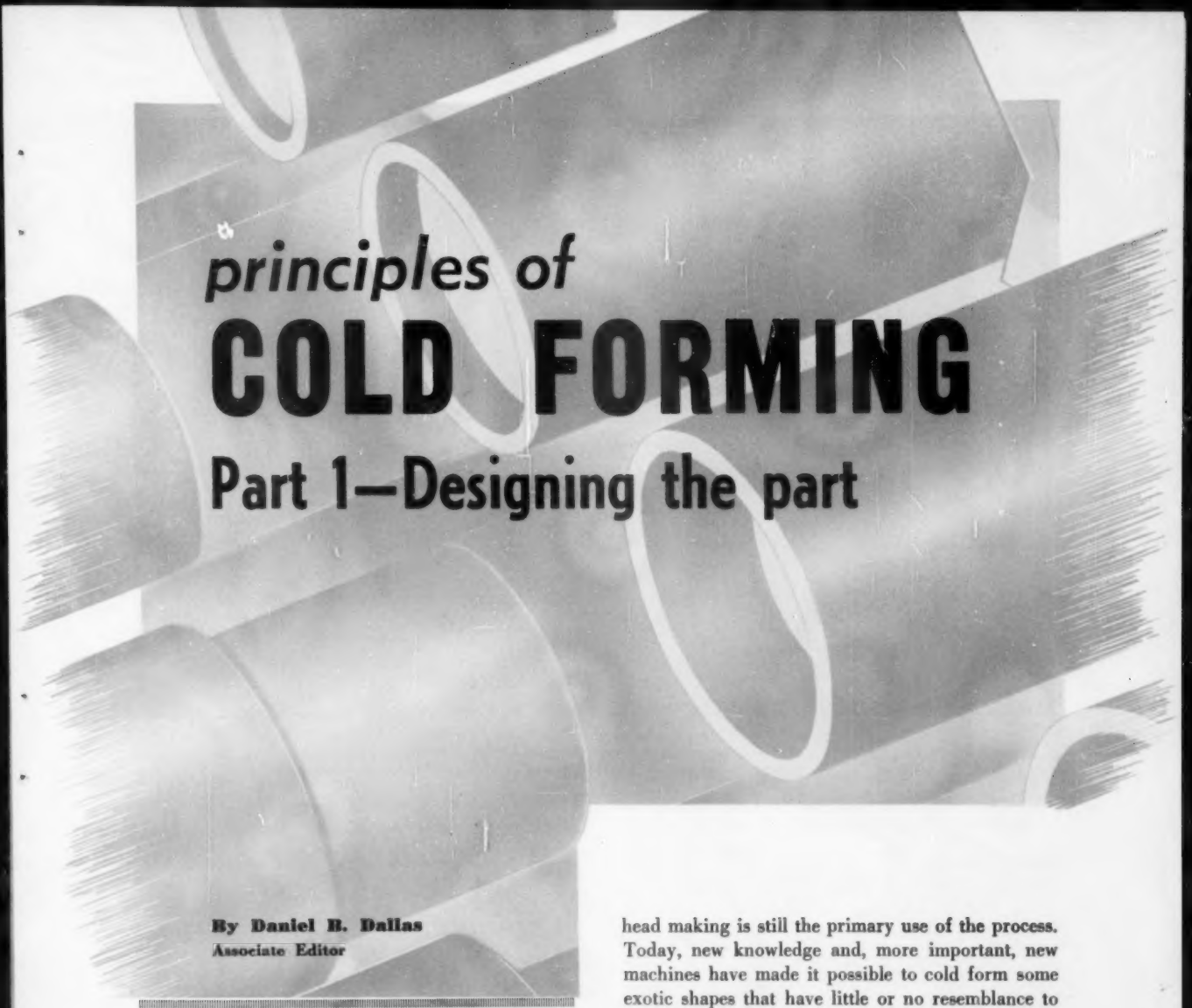
Parts-holding components of the quenching machine resemble a punch and die. In operation the punch descends, enters the rail in position on top of knockout rods die approaches and contacts the rail. Force for straightening the part is then applied. Quenching takes place simultaneously by means of water flow through the walls of the punch and die. After straightening and quenching, the part is elevated by the knockout rods and returned to loading position for ejection by pushers located at the rear of the machine.



TRANSFER MECHANISM withdrawing part from furnace. Action is fast to minimize heat loss between furnace and press.



QUENCHING MACHINE with heated rail in position for straightening operation. Furnace and control console are at end of machine.



principles of COLD FORMING

Part 1—Designing the part

By Daniel B. Dallas
Associate Editor

Many parts that are normally made on screw machines, by casting or by forging are ideally suited to production on cold formers. Generally speaking, cold formers mean low costs, high production and improved physical properties. In this article, the first of two on cold forming, some of the fundamentals of part design are discussed.

ALTHOUGH COLD HEADING has been used for a long time—at least a hundred years—it is only recently that industry has become aware of its full potential. For the greater part of its history it has been untilized for the comparatively simple job of producing the heads on bolts and screws. If statistics were available they would probably show that head making is still the primary use of the process. Today, new knowledge and, more important, new machines have made it possible to cold form some exotic shapes that have little or no resemblance to fastening devices.

Cold heading as such is essentially an upsetting operation. A cylindrical or shaped blank is held in a stationary die in such a way that, when a movable die advances, one end of the workpiece is upset. The upset end takes the shape of the movable die and, by using different dies, it is possible to form an imposing variety of head shapes.

Cold forming—the evolutionary end product of cold heading—received its greatest impetus toward maturity when someone conceived the idea of using several dies and a mechanical device for transferring the workpiece between them. Finally, because threading of the bolts and screws was still a secondary operation, it was decided to design a machine in which the workpiece could be threaded automatically. Thus came into being the modern bolt-making machine, an example of which is shown in *Fig.* 1. This machine, a National Machinery Co. Boltmaker, can produce a wide variety of screws and bolts (socket heads included) but it still rep-

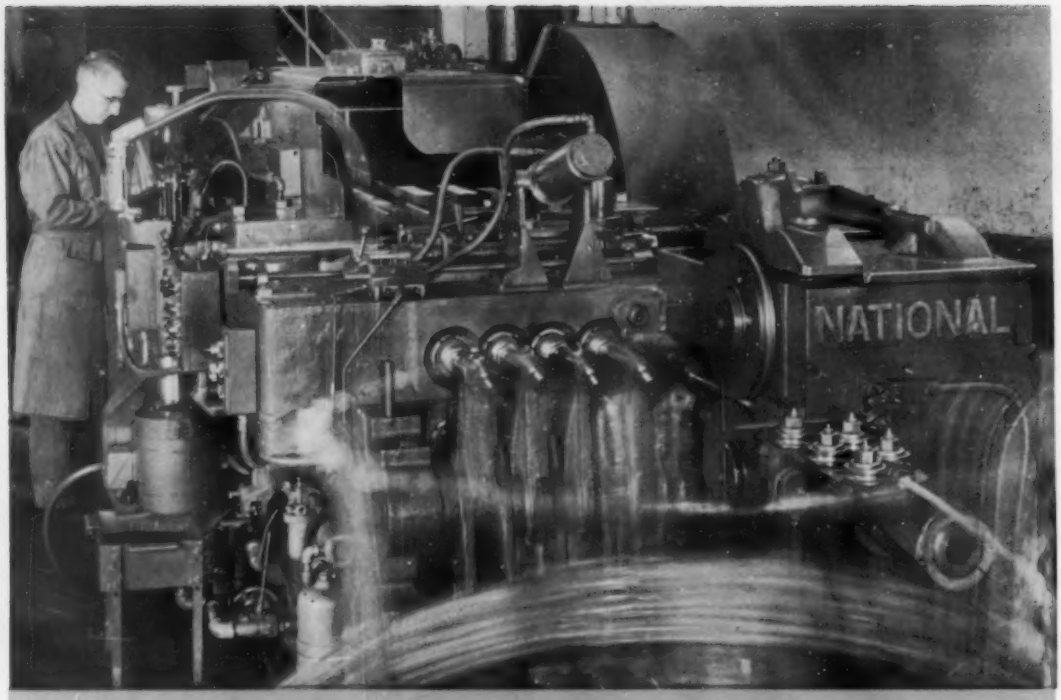


Fig. 1. Wire being fed through straightening rollers to a bolt-making machine. Speed of operation is captured in this simulated stroboscopic photograph.

resents only another step in the evolution of the modern cold-former, *Fig.* 2. This machine has seven working stations, one of which is a cutoff. The remaining six stations provide the designer with almost limitless opportunities to upset, form, extrude, coin, emboss and trim while working at either end of the piece. The limiting factor is generally the designer's ingenuity only.

Material: The material used in cold forming operations ranges from aluminum alloys to medium carbon steels. Stainless steels as well as copper and nickel alloys can also be cold formed. However, the success attained in use of these materials depends largely on the design of the part being formed. Here, as in many cases, the tool designer's experience should be relied upon heavily by the product designer. In virtually all bolt-making applications any of these materials can be used but in the more complex cold-forming operations, the feasibility of their use is often a subject of speculation even to experienced tool designers.

Because the material used in heading and forming operations is fed to the machine in coil form, it is referred to as wire. In bolt-making applications, wire sizes range up to 1⅜-inch diam and in cold formers 1½-inch wire can be used. Feeding is accomplished with rolls that draw the wire through a set of straightening rolls. After advancing past the straightening and feed rolls, the stock is sheared and fed into the first die by the transfer mechanism, *Fig.* 3. At this point the sequence of cold-heading or cold-forming operations begins in much the manner of a progressive transfer die.

Heading: Once in the dies, the workpiece can be headed to virtually any desired configuration. Some of the more basic heading designs are illustrated in *Fig.* 4. As is shown, offset heads are practical although they sometimes present problems in part transfer from die to die. When secondary operations such as hole piercing are performed, near perfect indexing is required although shallow leads on the dies can be designed to assist in locating the parts.

Screwdriver slots can be cold formed in the heads, although there is a restriction on their shape in some parts. In flat-headed parts such as shown, the slot must be radial instead of flat. This is to eliminate contact between the slotting punch and the die. In round-headed parts such as the one illustrated in *Fig.* 4, the slot can be straight.

Serrations on heads to facilitate manual handling are practical and are used extensively on cold-headed socket-head screws. These can be applied either by heading or by a secondary operation,

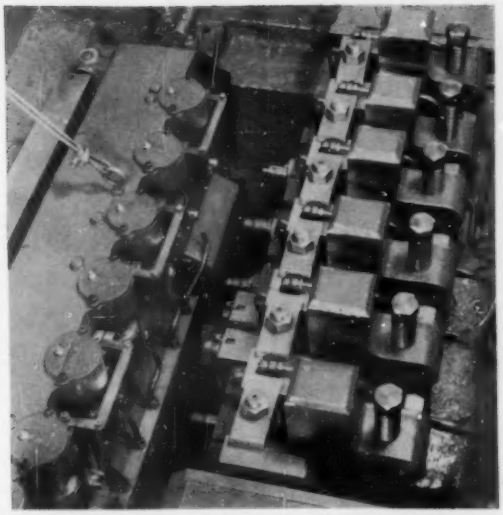


Fig. 2. Tooling area of a seven-station cold former. Extruding and forming punches are visible at the center; the part transfer mechanism and the partially finished workpieces are at the left.

the method selected depending almost entirely upon the nature of the serration. Virtually all types of serrations can be produced.

Locking Devices: Virtually all cold-headed parts are fastening devices such as screws and bolts. Often the applications in which they are used require that they be prevented from turning. Carriage bolts are good examples. In this type of fastener a square shank is formed immediately below the head. As the bolt is tightened, the shank sinks into the wood, effectively eliminating any possibility of radial movement, *Fig.* 4. This type of head can be cold formed but tooling is simplified if the product designer specifies two or four lugs instead of a square shank. If lugs are specified, the entire head can be made in a single die operation, but if a square shank is called for, two blows from an alternating die head are required.

Fasteners can also be prevented from turning by serrated shanks, *Fig.* 4. Like the serrated head shown at *Fig.* 4, this shank should be tapered to allow forming instead of shaving.

Extrusion: Many of the parts produced on cold formers are extruded in one of two directions: forward or backward. Forward extrusion occurs when a slug of metal is forced to enter a die diameter smaller than itself, *Fig.* 5. This type of extrusion is beneficial in that it cold works the metal and improves its physical properties. Considered strictly from the part designer's point of view, it is an efficient and highly economical method of creating two or more different diameters on the part being fabricated. If the designer can do so, it is to his advantage to make the angle between the two diameters as shallow as possible. The reason for this is that as the angle increases, the pressures required for extrusion also increase. Reduction in diameter is another factor which affects the amount of pressure required: the greater the percentage of reduction, the greater the pressure requirements. Generally, the part designer is unable to change the percentage of reduction since the two diameters have separate and equally important functions.

It is also advantageous to specify radial instead of angular shoulders, *Fig.* 6, if part function so permits. Extruding through a radial die lessens the danger of die breakage and improves the flow lines in the workpiece. The possibilities of breakage are lessened because tests have shown that dies of this type require less pressure to extrude successfully.

Backward extrusion—by far the more exotic form of extrusion—involves subjecting a slug of metal to pressure from an angular punch, *Fig.* 7. Because it has no other place to go, the metal literally squirts along the outer perimeter of the punch. Pressures required for this operation are high, ranging from 54,000 to 147,000 psi, and more depending on the material, reduction in area wall thickness and lubricants.

Backward extrusion provides the part designer with an excellent method of forming cylindrical shapes. He is, of course, confronted with the

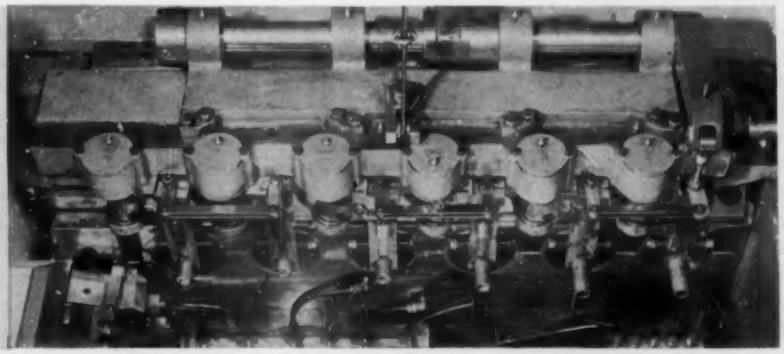


Fig. 3. Transfer mechanism of the seven-station cold former. Parts produced in this setup are wristpins for automotive engines. Positioned in the transfer mechanism, the parts are seen in varying degrees of completion.

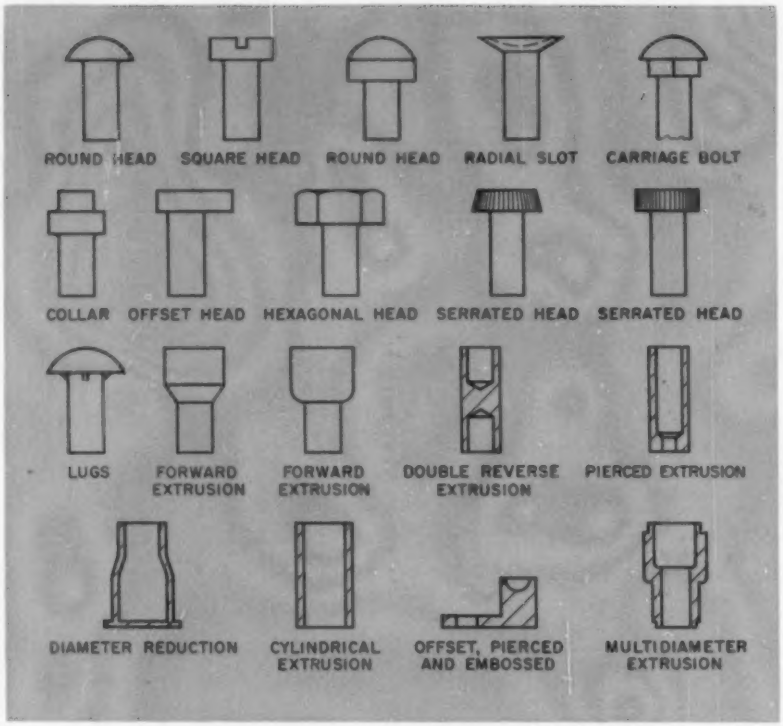
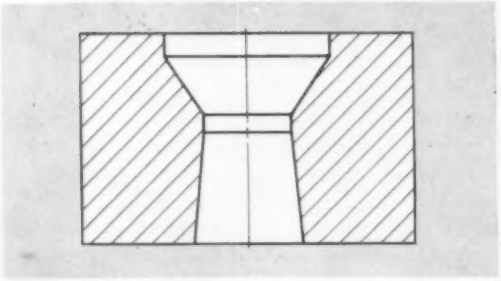


Fig. 4. Typical designs of parts manufactured by cold forming.

Fig. 5. (below) Design of die for angular extrusion. In dies of this type metal enters large diameter and is forced under pressure to size of smaller diameter.



necessity of using a part with a pointed hole, but generally this causes no great difficulty. In some cases—extrusion of beer cans, for example—flat extrusion punches have been used successfully, but in heavier metal angular punches have been found to be economically necessary. And the greater the angle, up to a point, the easier it is to establish plastic flow in the workpiece.

Because the highly versatile transfer mechanism of the seven-station former can turn a part through 180 deg between dies, the designer can consider the use of two backward extrusions on the same workpiece. An example of this is shown in *Fig.* 4. In this example the part is extruded at one end, reversed and then extruded at the other end. Finally, if it is necessary to have a through hole, a piercing operation can be brought into play in a subsequent station. This type of operation will be discussed in greater detail in the article on tooling.

Corner Design: In all cases of plastic flow, sharp corners are to be avoided, *Fig.* 8. In sheet-metal draw dies, for example, the designer cannot expect metal to flow over a sharp die wall. Similarly, in heading and extrusion dies, he must allow for metal flow when the product is designed. If sharp corners are necessary, they can be obtained in cold-forming applications, but generally at the expense of tool life. Once the part has been formed into the desired shape, a restrike type die will coin the radii to zero, but it should be remembered that such dies have a high mortality rate. The best policy is to specify the largest possible radii at all corners.

Part Symmetry: Symmetrical parts are the easiest to cold form. This was pointed out in the discussion of head shapes and what was said there is even more applicable to body shapes. Unsymmetrical parts—and even parts that are symmetrical but noncylindrical—present problems in die-to-die transfer. Although these problems are not insurmountable, they call for close liaison between the product designer and tool engineer. Cylindrical parts require only that the transfer mechanism move them from one die to another, but unsymetrical parts require radial positioning at each station.

In addition to problems in positioning, unsymmetrical parts can cause interrupted grain flow in the metal. Normally, cold-formed parts have improved physical properties, but these properties are

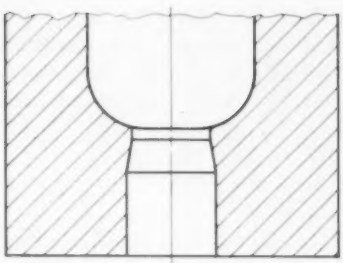


Fig. 6. (left) Forward extrusion die. Extrusion through this die is similar to that of Fig. 5.

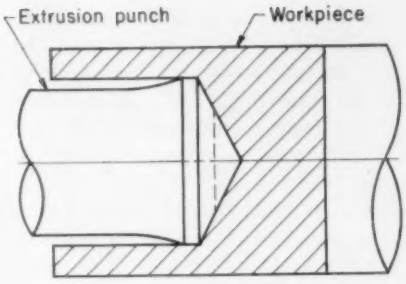


Fig. 7. (right) Backward extrusion of metal. Pressure of punch on blank causes metal to squirt along outer perimeter of punch.

attributable to improved flow lines and refined grain structure, *Fig.* 9. Should design be such that grain flow is interrupted, the finished part may be weaker, not stronger, than the original wire.

Threading: Threading operations are easily performed as secondary operations within the National Machinery Boltmaker. After the part has gone through its various heading operations, it is transferred by way of tubes and tracks to a set of roll threading dies. Made of air-hardening tool steel, these dies can roll virtually any type of thread or knurl. Most parts that go through the dies are threaded at one end only, but it is possible to alter the dies to permit threading at both ends.

Tapered Parts: Taper can be a problem in cold-formed parts, especially if it extends down the entire length of the body. If the taper is comparatively small, problems in this respect are minimal, but if it is large, the part is difficult to form and it presents problems in die-to-die transfer of the workpiece. Unfortunately, because there are so many variables to consider when designing tapered parts, no general statement regarding this factor can be made. As in many other problems of cold forming, the part designer must rely heavily on the tool designer who, in turn, must rely heavily on his experience, intuition and common sense.

Finish: In many cases, the die operations involved in cold forming result in improved surface finishes. Extruding, for example, will improve surface finish from 10 to 100 microinches. On the other hand, upsetting operations incidental to head formation generally decrease the quality of surface finish unless extremely high pressure can be brought to bear on the side walls of the containing die. If high-quality finish is required in the finished part, it is necessary to use high-quality wire. The wire should be perfectly clean as a result of deoxidization in an acid bath and neutralization in lime. The wire should then be lubricated before cutoff.

Tolerances: Practically the only limit on dimensional accuracy in cold forming is the amount of die wear the customer is willing to accept. As in many other areas of tool and manufacturing engineering, tolerance is not a matter of mechanics, it's a question of economics. For example, parts have been cold formed to tolerances of 0.0005 inch through use of sizing dies. After prolonged use, however, dies wear and the parts lose size.

Another limitation on tolerance is the amount of work accomplished in the die sequence. If a comparatively large number of operations are performed, there isn't enough room in the sequence to accommodate a sizing die. In these cases, all sizing is accomplished by the extruding and forming dies.

In most cases, the designer is safe in specifying from 0.001 to 0.002-inch tolerance on all diameters. Part lengths can be held to 0.005 inch without difficulty although ± 0.005 inch is more practical from the tool designer's point of view.

Cutoff: No operation in a cold-forming sequence is more important than the cutoff of wire as it enters the machine. First of all, the wire must be

Fig. 8. Cutaway view of automotive wristpin made by cold forming. Slug at left is pierced from the center of the pin after final formation.

cut to tolerances at least equal to the tolerances specified for over-all part length. The reason for this attention to the cutoff blank is that the volume of the finished part will equal the volume of the blank. Since part dimensions and part volume are mutually interdependent, it follows that the blank must be cut to an exact size.

Secondly, the ends of the blank must be square. Should an end be angular, it would be difficult, if not impossible, to set up an even plastic flow in the workpiece. While this would be of relatively small importance in upsetting operations, it would make the holding of length tolerance in extruded components an impossibility.

In National Machinery's seven-station former, cutoff problems are resolved with the cutter-quill design illustrated in *Fig.* 10. After the wire has advanced through the feed rolls, it enters the quill and cutter. Holes in these units must be held in perfect alignment to permit unobstructed passage of the wire. After the wire has been advanced through the cutter to a positive stop, the cutter is actuated in a vertical direction, shearing off the workpiece.

Clearance between cutter and quill is critical. Unlike conventional shearing dies, however, the clearance is not uniform. The depth of clearance is obtained by multiplying the wire diameter by 0.037. This depth is ground "straight through" and is blended into a radius r which is equal to D, the diameter of the rod. Thus, in *Fig.* 10

D = Wire diameter
$d = D \times 0.037$
$r = D$

The values of r and d will vary to some extent, depending on the hardness of the stock. As stock increases in hardness, d should be decreased slightly with r remaining equal to D. As stock decreases in hardness, d will increase slightly and r will decrease slightly. These formulas can be regarded as applicable to cold-drawn steel such as 1020.

Tooling Area: As the blank leaves the cutter, it is moved by the transfer mechanism to the first die station, *Fig.* 3. In this illustration all dies are visible as cylindrical components immediately beneath the transfer unit. The workpieces, which are seen at the die stations in varying degrees of completion, are wristpins for automotive engines. Although this is a good pictorial view of the tooling area, a drawing of a typical tool layout, *Fig.* 11, presents a more accurate picture of the dies.

In this layout, a slug is cold formed into gear blank for an automotive door latch. Three die stations are involved. In the first station, the blank is forced into an extruding die that reduces its diameter and flattens the outer end. The part is then transferred to the second die. At this station the extrusion at one end continues while head formation begins at the other end. In the third station the head receives its final formation and is dimpled with a spherical configuration.

Two basic cold-forming operations—heading and extruding—are completed in this tool layout. The manner in which these operations are performed, the rules of tool design insofar as they can be

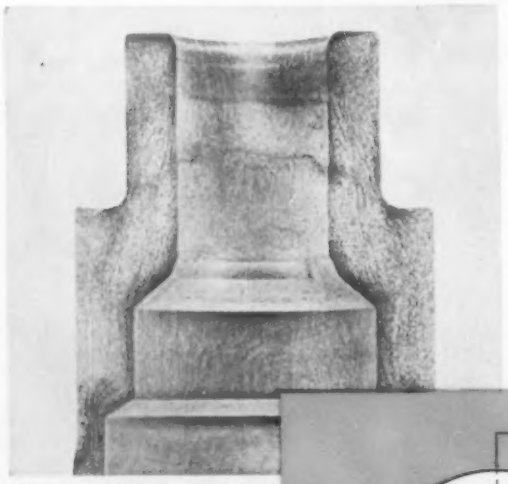


Fig. 9. Cold formed part cut in two for demonstration purposes. This view shows flow lines and improved grain structure resulting from cold forming.

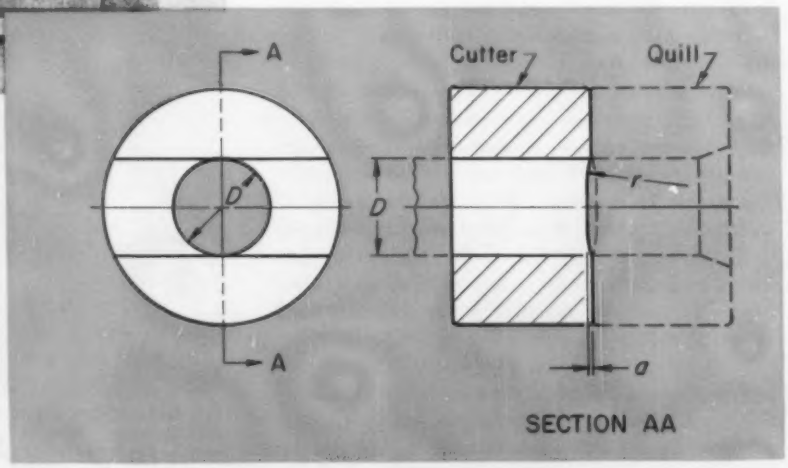


Fig. 10. (right) Drawing of forming die for cutting wire as it enters tooling area. Value of radius varies slightly according to hardness of material cut.

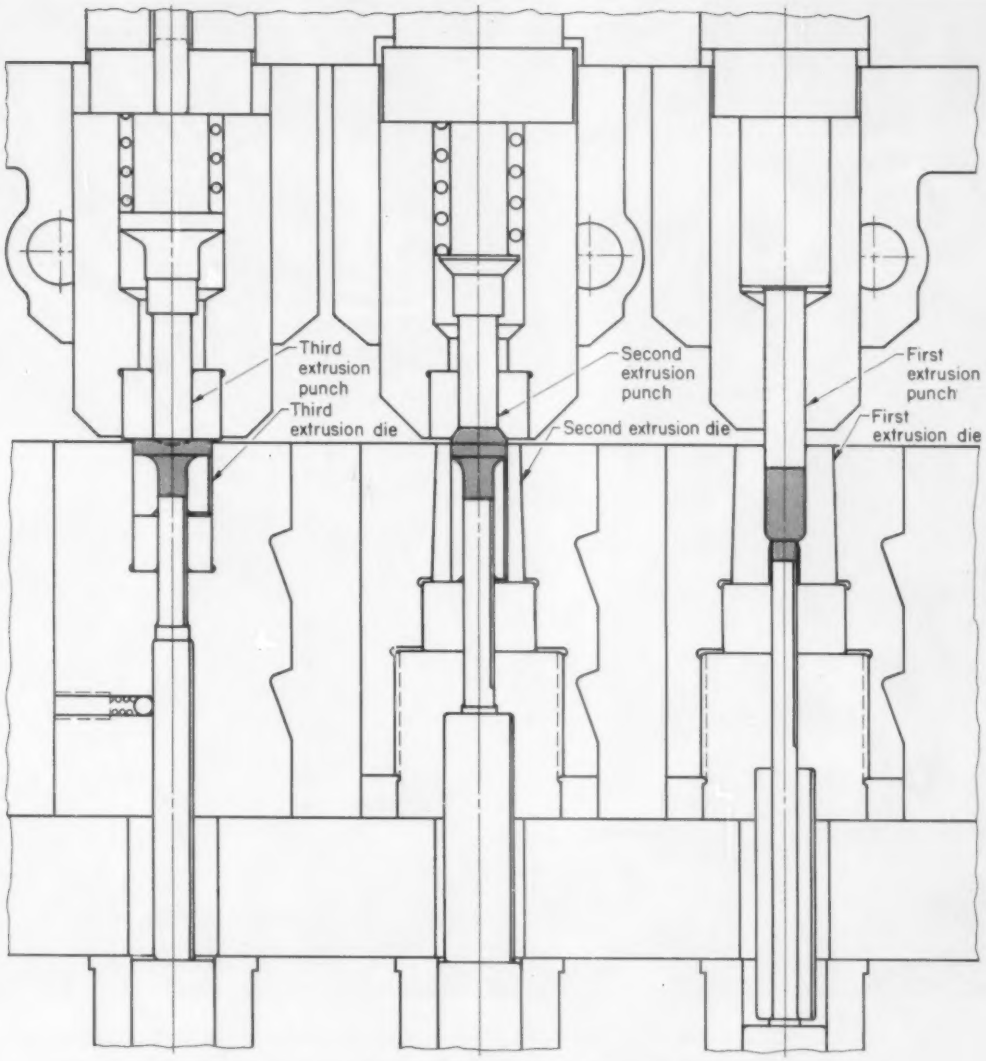


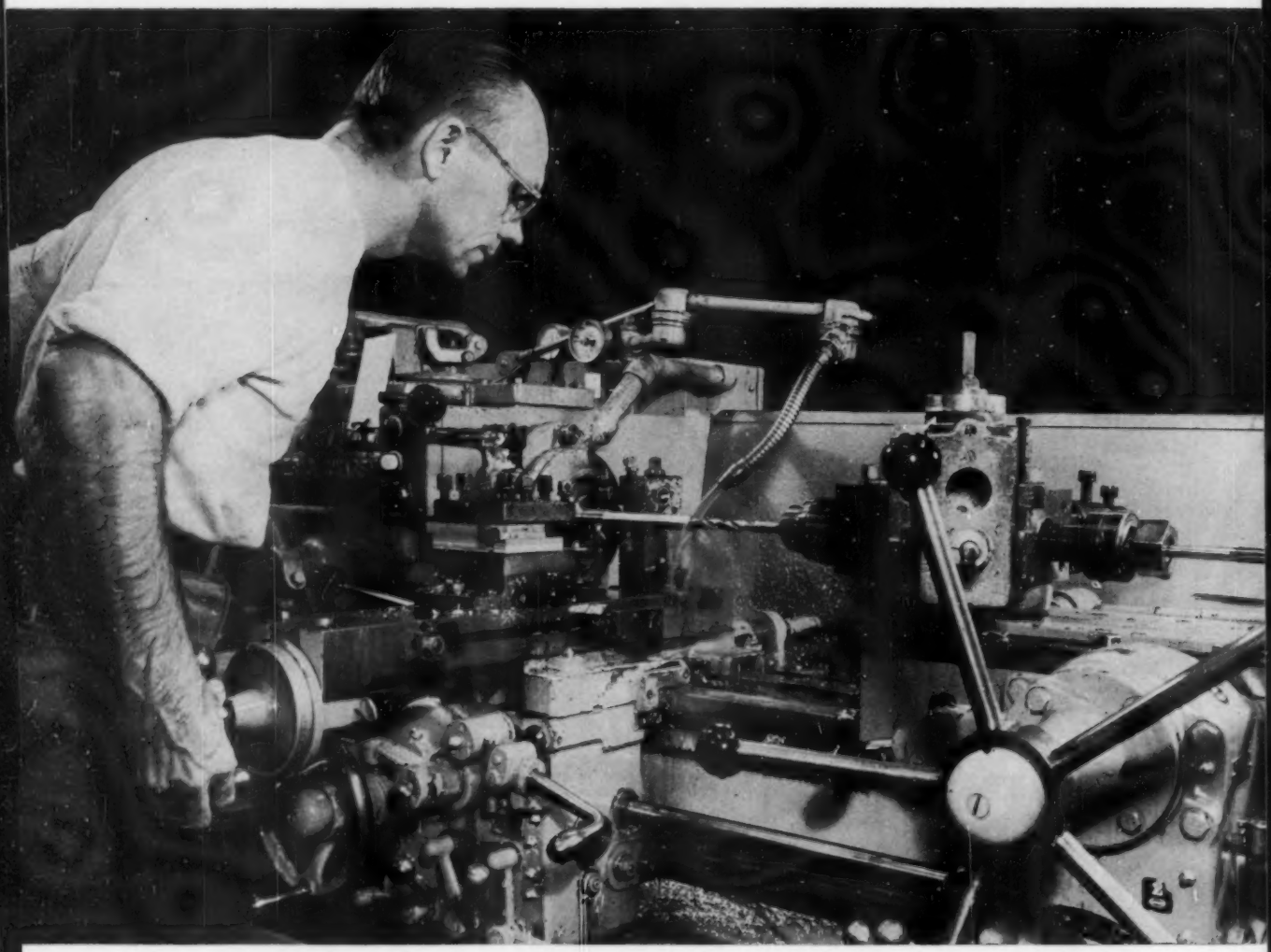
Fig. 11. Tooling area of a cold former. In this layout only three stations are required to form a metal blank into an automotive door latch.

codified, and the precautions that must be taken in establishing a layout will be discussed in the second article of this series. Meanwhile, it would be well to close this article on part design with a summary of the advantages of cold forming.

Why Cold Form? Probably the greatest advantages of cold forming are the speeds of operation possible and the economies of material inherent in the process. Each of these contributes to a third advantage—lowered costs of production. In addition, improved metallurgical characteristics of the metal make the process ideal for components in which strength is a factor of importance.

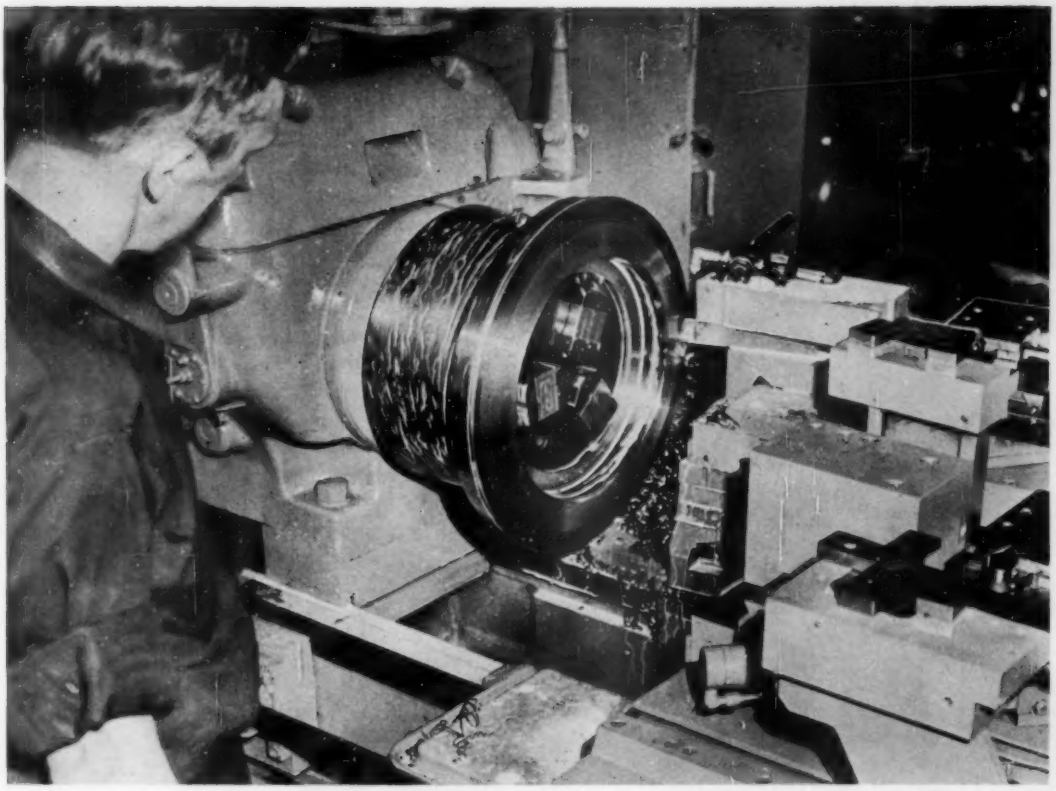
Because speeds will vary, depending on the machine used, the material being formed, and the sequence of operations involved, no general statement regarding speeds can be made. Some specific examples can be offered, however. In cold-heading operations, speeds of 450 per minute have been attained on some parts. In the cold forming of wrist-pins, *Figs.* 3 and 8, production is 50 per minute, a figure that appears to be a good average for complex extrusions.

With regard to economies of material, cold forming is a type of chipless machining. The only scrap involved results from piercing operations and this is generally a factor of negligible significance when it is measured against the total volume of the part. In any event, holes are the same whether made on screw machines, punch presses or cold formers. In evaluating the process it can be said that the cold former has reduced the percentage of material lost by way of scrap to a minimum.

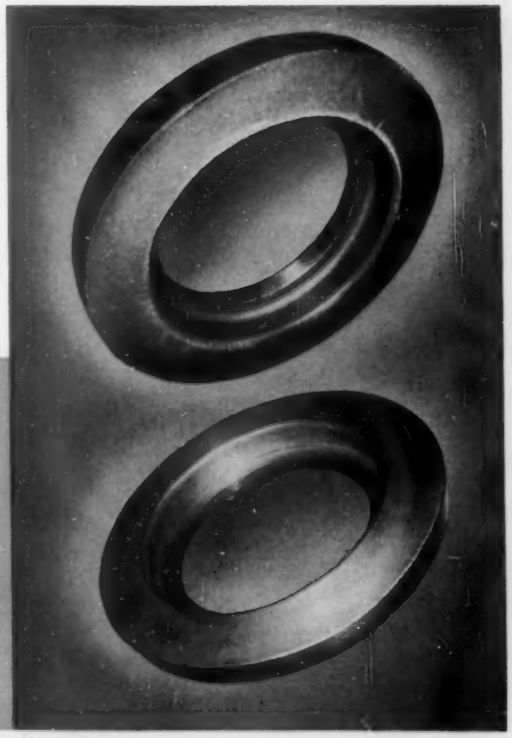


LIGHT-VISCOSITY COOLANT (Gulfcut IID) keeps the chips flowing freely during machining of a 5.510-inch hole in an oil level indicator for an aircraft primary hydraulic system. Operations on the aluminum workpiece include center drill, flat-bottom drill, countersink, rough and finish turn. Drilling speed is 460 rpm. The drill is fed by hand. The machine is a Warner & Swasey turret lathe; the operation is at Chance Vought Corp.

TOOLS at work



RING GEAR FORGINGS from 6 to 24 inches in diameter are handled on this standard lathe, modified by the addition of a double hydraulic tracer conversion system. Two cemented carbide cutting tools brazed to straight shanks perform seven different operations. The front tool (retracted for part loading in the photograph) turns the back angle of the gear blank and also turns a radius and front face angle. Simultaneously, the rear tool turns a radius, bores the inside diameter, faces the web and chamfers the bore. Machining is done at 200-fpm speed, 0.015-ipr feed. The conversion system was designed and built by Detroit Broach & Machine Co.

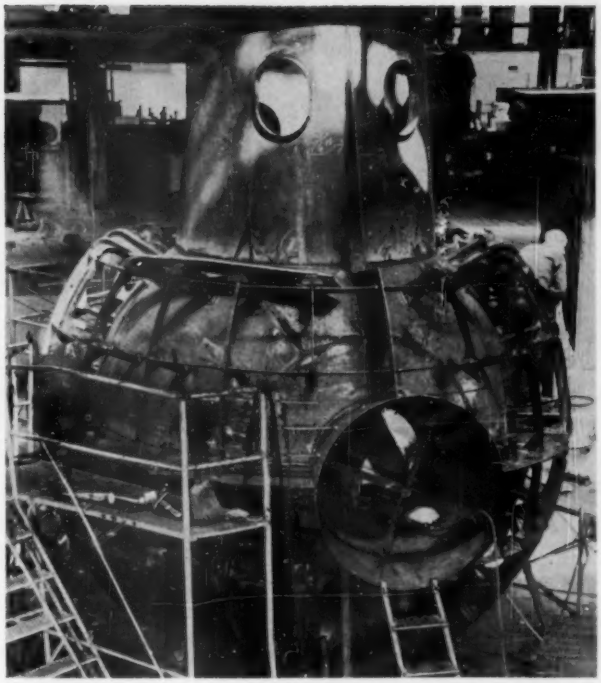


AISI 4140 STEEL ring gear forging (top) is placed in a standard lathe converted to double tracer operation for machining. Six minutes later it is completely finished (bottom) and 26 lb lighter. Original weight is 120 lb. Previously, machining was performed on three machines, requiring long setup.

TOOLS at work

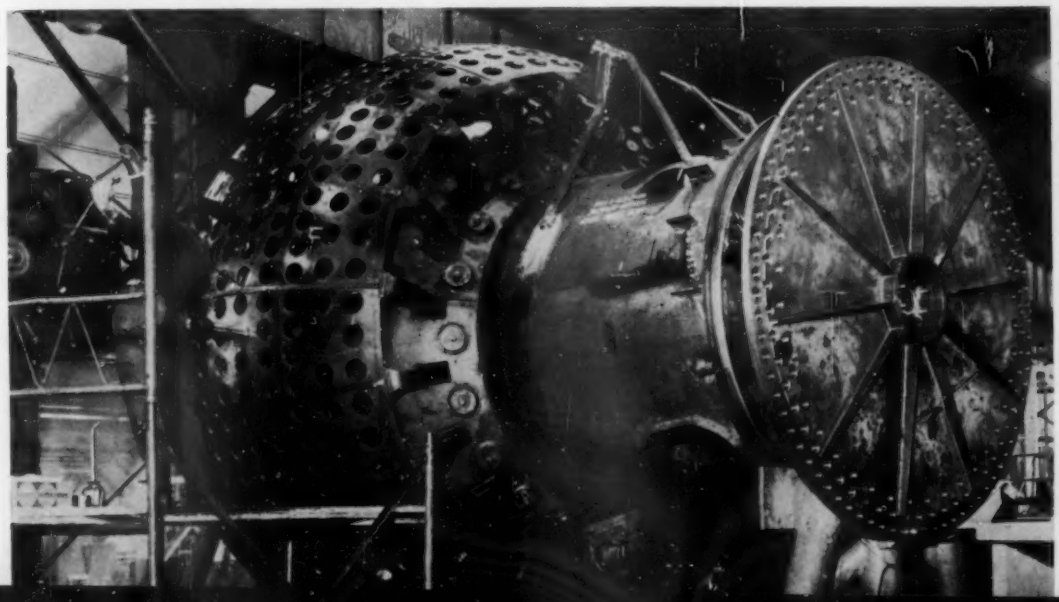
ONE HUNDRED PERCENT radiographic inspection of weld seams is necessary on this 11-foot-diameter inner sphere that houses electrical equipment on the Navy's latest attack submarine. The sphere, which must be round within +0.25, —0.50 inch, is of one-inch-thick sections of HY80 armor plate. These were press-formed, heat-treated for temper, then joined into two hemispheres by tack-welding sections over bar stock steel frames. Following removal of the frames, all seams were completed by multiple-pass electric arc welding. Here the operator is performing the radiographic inspection operation. The sphere was fabricated at Baldwin-Lima-Hamilton Corp.'s Industrial Equipment Div.

AFTER THE INNER SPHERE is fabricated, support cones, an entry cone and the rib structure around which the outer, incomplete sphere will be built, are welded in place. Spacing between the outer and inner spheres is held to 18 inches, ± 0.0312 inch, to insure concentricity. More than 50 different sizes and shapes of segments are joined to form the five horizontal and 19 vertical ribs. Spacing between ribs is maintained to accuracy within 1 degree. Here operators are completing the rib welding operations on the sphere.



AFTER AN OUTER SPHERE is welded over the ribs of the massive weldment being fabricated by Baldwin-Lima-Hamilton for the Navy, sets of holes are drilled in both the outer and inner spheres. Holes must be spaced precisely according to a latitude-longitude chart supplied for the job. Holes in the outer and inner spheres are of different diameters and each hole must be drilled on a centerline which, if projected along the axis of the drill, would intersect the geometrical center of the inner sphere. Maximum angular tolerance is 3 min off true centerline, measured at the surface of the inner sphere.

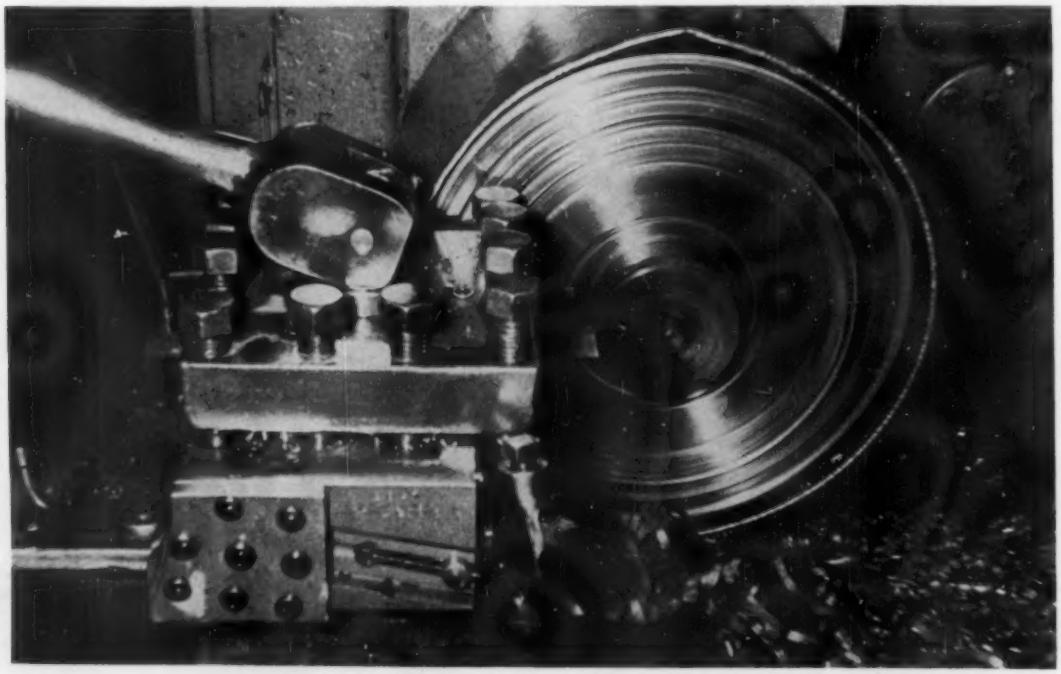
Drilling is performed in a standard horizontal boring mill. The assembly is fitted with shaft ends so that it can be cradle-mounted on a standard indexing table. This table has a vernier adjustment that permits positioning the sphere surfaces precisely under the stationary drill heads in the lateral plane. A chain drive rotates the assembly in the vertical plane past the drill heads. These two positioning arrangements permit full movement on both vertical and horizontal axes. A circular steel template (at right in photograph) accomplishes precise vertical positioning. Each hole in the template corresponds to a hole in the workpiece. The operator rotates the assembly until the desired template hole is lined up with a master hole, puts a pin into the lined-up holes and proceeds with drilling. Use of the template makes precision drilling simple and foolproof under shop conditions.



TOOLS at work

CORROSION AND ABRASION resistance of an 18-inch-diameter cast iron ram used in a rubber extrusion press is increased by giving it a metallized coating of Type 420 stainless steel at Burd Machine & Tool Corp. The ram is first machined down to clean metal (at least 0.050 inch undersize on each side). The turned surface is then threaded. A thread 0.040-inch deep, with 22-28 threads per inch provides optimum mechanical bonding surface for the metallizing powder. Threading is followed by wire brushing and a carbon tetrachloride rinse. Before metallizing, the workpiece is heated to 300-400 F. With the ram rotating in a lathe, the stainless steel powder is applied to the threaded surface. Successive passes are made to bring the deposit to a thickness of about 0.060 inch per side, leaving about 0.010 inch for removal during finish grinding. Colmonoy spray equipment is used.

HIGH RIGIDITY of a tungsten carbide tool shank has enabled a manufacturer of printing machinery to eliminate an extra facing operation when cutting small gear blanks from 2⅞-inch diameter bar stock. There is a tolerance of ±0.0005 inch in parallelism of the two faces of the 0.250-inch-thick disks, which are cut from 2⅞-inch-diameter bar stock of Type 6/6 filled Nylon. The original cutting tool had an I-beam cross section and was 3/16 inch wide, 1⅛ inch high and 6 inches long. This tool has been replaced by a 6-inch-long bar of Kennametal tungsten carbide, ⅛ inch wide and ½ inch high. A hard carbide tip is brazed on the end for cutting edges. The tool projects 1¾ inches from the tool block to permit cutting to the center of the workpiece. With the tungsten carbide shank, clean, parallel gear blanks, well within the specified tolerance, are cut off in one operation, with substantial savings.



standard dimensioning for jig bore drawings

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When the proper hole layout and appropriate tolerances are applied on all tooling and engineering drawings, maximum efficiency can be obtained from jig boring operations. The standards developed at Lockheed should be widely applicable in industry.

WITH TODAY'S EMPHASIS on simultaneous cost reduction and quality improvement, manufacturing engineers are taking a close look at all aspects of production. The capabilities of men and machines are being studied, often with fruitful results. At Lockheed, for example, the method of dimensioning used on jig boring drawings has been standardized so as to increase machine productivity and minimize the possibility of operator error.

The standard dimensioning methods cover about 90 percent of all jig boring operations and are compatible with the programming systems used for numerically controlled machines. In some instances, the basic starting point of the drawing may have to be revolved 90 or 180 deg to conform to the standards. This is not objectionable.

Dimensions shown on designs for tools or components to be jig bored should read the same as the settings to be made on the machine. This minimizes the possibility of operator misunderstandings that lead to error.

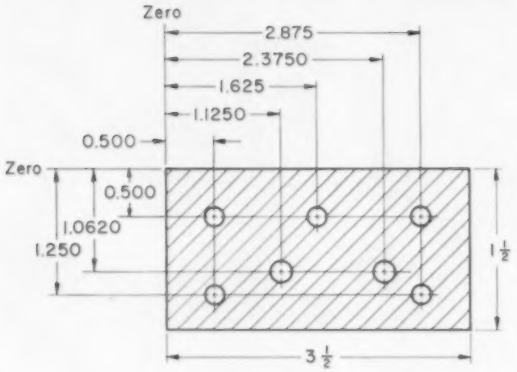
Allowable tolerances are shown in the title block of most drawings. If tolerances are not standard, they are shown on the field of the drawing. Tolerances for jig bore work are governed by a percentage of engineering blueprint tolerances. Common sense must govern dimensions where larger tolerances are allowable.

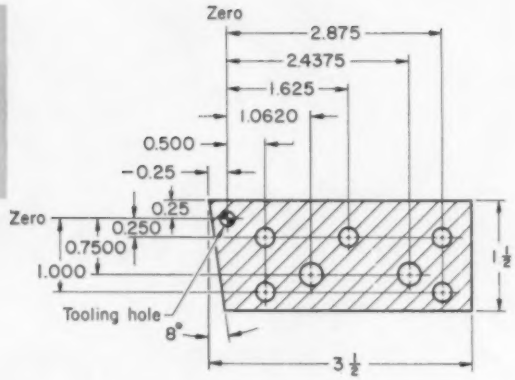
Drawings are dimensioned for jig boring when tolerances between holes are ± 0.005 inch or less. Drawings are also dimensioned for jig boring if tolerances between holes are in the ± 0.005 to ± 0.010-inch range and the workpiece has a large number of holes.

A preferred method of coordinate dimensioning

Fig. 1. (below) Preferred method of coordinate dimensioning for jig boring. It is assumed that the top and left-hand surfaces are finished.

Fig. 3. (right) When the left-hand and top surfaces of the workpiece are at an angle other than 90 deg, a tooling hole is the zero point.





is shown in *Fig.* 1. In effect, the workpiece is bracketed within a pair of intersecting lines that are normal to each other. Coordinates are actual distances from these lines to the centerlines of holes. The zero point for both lines is in the upper left-hand corner. All dimensions read the same as the settings, to be made on the machine by the operator —no calculations on his part are required.

When large numbers of holes are to be dimensioned for jig boring, the chart method, describing *X* and *Y* coordinates for each hole, is used, *Fig.* 2. This method simplifies the drawing.

Another method of showing jig bore dimensions is by referring the desired hole pattern to a reference point such as a tooling hole. This point should be in the upper left-hand corner, *Fig.* 3. A dimensioning system of this kind is used when the top and left surfaces of the workpiece being bored intersect at an angle other than 90 deg, which means that their surfaces cannot be used for reference planes as in *Figs.* 1 and 2.

The advantages of having the zero lines emanate from a point become apparent when an existing hole is used as the zero point. With this procedure, all figures are designated as positive values. By using the zero line system, the dimensions are all taken from outside the hole patterns.

When locating pads are not accessible for reference, the method shown in *Fig.* 4 is used. A tooling hole that adheres to the zero line system is established at the inner intersecting planes of the locating pads.

Holes on circles can be laid out either in polar coordinates (angle and distance) or in rectangular coordinates, *Fig.* 5. Polar coordinates are more convenient and easier to calculate. Unless one of the new precision optical rotary tables is used, however, more accurate results are obtained when a conventional table and rectangular coordinates are employed.

There are tables available that facilitate calculations of polar coordinates or of rectangular coordin-

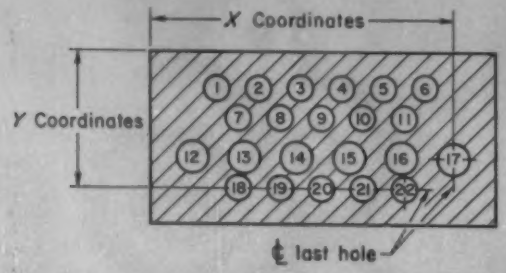


Fig. 2. When there is a large number of holes, each hole is numbered and coordinates are listed on a chart.

Jig Bore Coordinates

Hole No.	X Coordinate	Tolerance (inch)	Y Coordinate	Tolerance (inch)
1	0.250		0.250	
2	0.7500		0.2500	
3	1.125		0.250	
4	1.750		0.250	
5	2.1870		0.2500	
6	2.750		0.250	
7	0.500	±0.0025	0.500	±0.0125
8	1.0000		0.5000	
9	1.375	±0.0015	0.500	±0.0015
10	2.000	±0.0015	0.500	±0.0015
11	2.6250		0.5000	
12	0.250		0.875	
13	0.7500		0.8750	

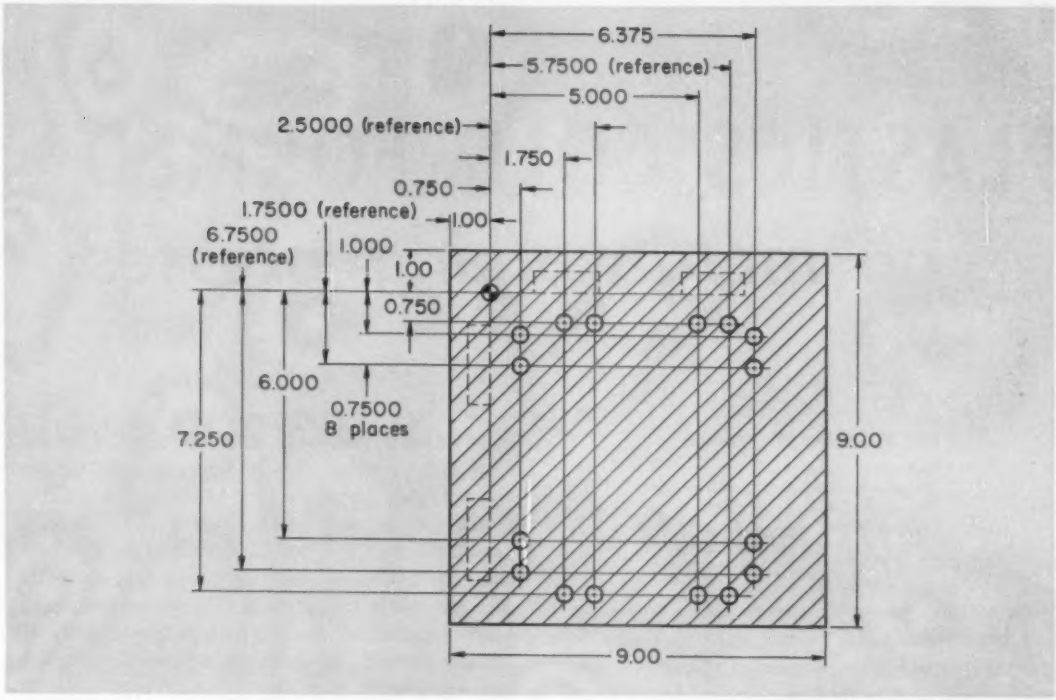


Fig. 4. Tooling hole was established at the inner intersecting planes of the locating pads of this workpiece because the locating pads were not accessible for reference.

Fig. 5. (right) Method of laying out holes in circles. Zero point is at upper left.

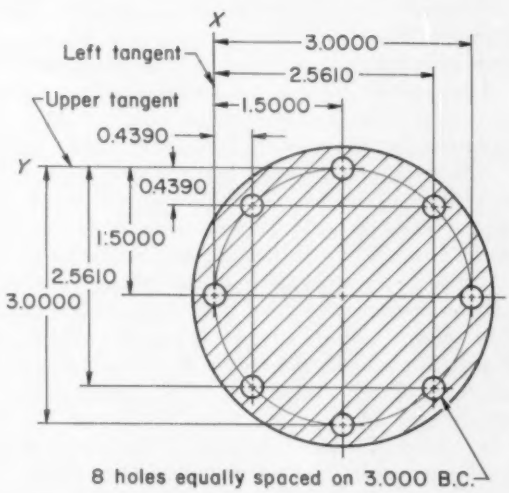
Fig. 6. (lower right) Standard dimensioning method for a typical small jig-bored part.

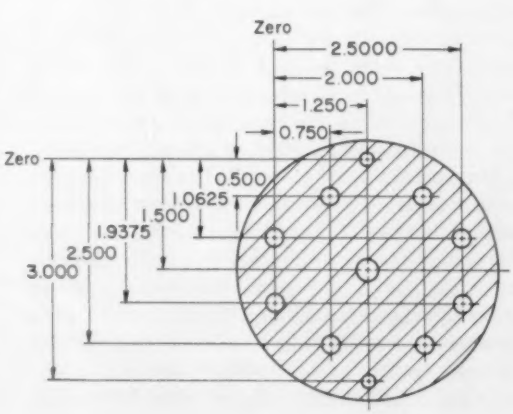
ates of holes on circles. Using these tables, rectangular distances from the left tangent and the upper tangent to the circle, or to a point (tooling hole) outside the circular pattern, can be obtained by simple multiplication.

A chart method such as the one shown in *Fig.* 2 can be used for either the rectangular or polar coordinate method. In the latter method, degrees, minutes and seconds, rather than linear units of measurement, are used.

A typical part that might be produced in small quantities on a jig borer is shown in *Fig.* 6. The same holes could be incorporated in a drill jig to be used in mass producing identical parts.

All dimensions for the holes are located from the zero lines at the top and left. Dimensions are set on the machine exactly as they appear on the drawing to which the operator is working. There is no need for the operator to add or subtract measurements. He establishes a zero point for the first hole, then duplicates the drawing dimensions on his measuring instruments, working from the established zero point. This minimizes the chances for errors, leads to greater precision.





PLASTICS COLD FORMED
on metalworking presses

By Francis M. Mallee
Research Engineer
Materials Research Laboratory
The Budd Co.
Philadelphia, Pa.

FOR YEARS, tool and manufacturing engineers have been looking for plastic sheet that can be formed on metalworking presses. Unlike the ductile metals, most plastics tend to crack or break when cold-formed. Even if not broken by the forming operation, plastics tend to return to their original shape after forming—deformation is not permanent.

A new plastic called polycarbonate resin may be the answer. This material has a combination of properties that are needed for successful cold forming. At room temperature, it has high ductility and high plastic elongation. Tensile elongation, for example, ranges up to 90 percent and notched Izod impact strengths are 16 ft-lb per inch of notch.

Further, polycarbonate resin has a low elastic ratio as compared to other plastics. Its ratio of yield point to ultimate strength is less than 0.50 at 20 percent cold reduction. It has moderate rigidity and the modulus of elasticity of 20 percent cold reduced material is 404,000 psi.

Deformation under static load is slight, even at high temperatures. Under a 4000-psi load at 160 F, deformation is only 0.3 percent. Heat distortion temperature of the new plastic is 280 F.

To a tool designer, these properties add up to formability about as good as that of low-carbon steel. It should be possible to accomplish a forced ductile deformation in polycarbonate resin sheet and that deformation should last for a long, long time.

The formability of polycarbonate resin sheet has been confirmed by a series of laboratory and production-line tests at The Budd Co. Polycarbonate was readily deep-drawn by double-action metalworking tools during the tests and stretch patterns showed that in everything except springback characteristics the material is excellent from a forming standpoint. It can be formed like metal.

Polycarbonate's tendency to spring back is accounted for by its low modulus of elasticity, which, even after considerable cold work, amounts to only about 1/65th that of steel. It has to be subjected to a strain of at least 0.4 inch per inch to assure a permanent set of at least 85 percent of the deformation. To tool designers, this means that each 0.5-inch element in the side wall of a cup type stamping has to be stretched to 0.70 inch (approximately 40 percent stretch) in order to achieve a 0.60-inch permanent set.

The tensile force that is needed for permanent deformation can usually be obtained by blankholder action. When there are large areas of the blank that will not set, compressive forces can be added by the coining action of tighter clearances.

Much smaller punch loads are required to deform polycarbonate than are required to deform carbon steel. When drawing a two-inch-diameter flat-bottomed cup to a depth of ¼ inch, the punch load for polycarbonate is 350 lb; the punch load for steel is 3400 lb. Once a polycarbonate blank begins to draw in, it can be kept in motion with increases of about 400 lb per inch of draw.

Polycarbonate can be formed at the same speeds used to form metal stampings. It responds well to contact velocities of 30 fpm. Depth of draw for a two-inch-diameter flat-bottomed cup is limited to 1⅜ inch on a mechanical press. At the low speeds obtainable with hydraulic presses, it is possible to make deeper draws.

Because the new plastic can be rolled, stamped and drawn on metalworking equipment, it should lead to economies in production. A word of caution: polycarbonate resins make it possible to produce plastic parts on metalworking equipment. But, in most cases, those plastic parts won't be satisfactory replacements for metal parts. They can, however, replace existing parts made from conventional hot-formed plastic materials.

This article is based on information from Paper 381, "A Plastic Sheet That Can Be Cold Die Formed," presented at the 29th ASTME Semiannual Meeting. Copies of the complete paper, which contains full test results and data on tool design, can be purchased from ASTME Headquarters, 10700 Puritan Ave., Detroit 38, Mich.

REFERENCE SHEET

development of right regular cone blanks

By M. W. Loftus
Chicago, Ill.

PARTS manufactured from sheet metal cone blanks range all the way from funnels and hoppers to jet engine sections. Formulas presented here are more direct than many in common use, and will save time and effort when applied as shown.

Estimating time can also be saved by applying the nesting formula to find the total amount of material needed to produce the blanks economically from sheets or strips.

Dimensions in the example are approximately those of a jet engine conical section. Parts of this type are invariably held to close dimensions with small tolerances. In manufacturing, the required precision is obtained by expanding the "cone" after welding, then trimming both ends to dimensions.

To develop a required cone blank, the dimensions needed are the major diameter D, the minor diameter d, the distance between the major and minor circles H, and the sheet metal thickness t. Other values can be derived from these, *Fig.* 1.

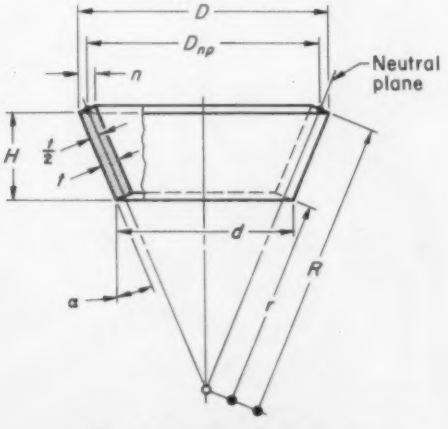


Fig. 1. Graphic relationships.

$$\tan \alpha = \frac{D-d}{2H} \quad \ldots\ldots (1)$$

$$n = t \cos \alpha \quad \ldots\ldots (2)$$

$$D_{np} = D-n \quad \ldots\ldots (3)$$

$$R = \frac{D_{np}}{2 \sin \alpha} \quad \ldots\ldots (4)$$

$$r = R - \frac{H}{\cos \alpha} \quad \ldots\ldots (5)$$

These values are used in *Fig.* 2 to get the dimensions of the developed blank:

$$\theta = \frac{\pi D_{np}\, 360}{2\pi R} = \frac{180\ D_{np}}{R} \quad \ldots\ldots (6)$$

$$L = 2\left(R \sin \frac{\theta}{2}\right) \quad \ldots\ldots (7)$$

$$W = R - r \cos \frac{\theta}{2} \quad \ldots\ldots (8)$$

For cones with close dimensions and small tolerances, requiring expanding and trimming after welding, radius r is reduced to allow material for trimming, and blank width W is increased by the reduction in radius, times the cosine of $\theta/2$.

Stock needed for most economical production of blanks from sheet is shown in *Fig.* 3, in which s, the allowance between blanks, is $3t/2$. For large blanks

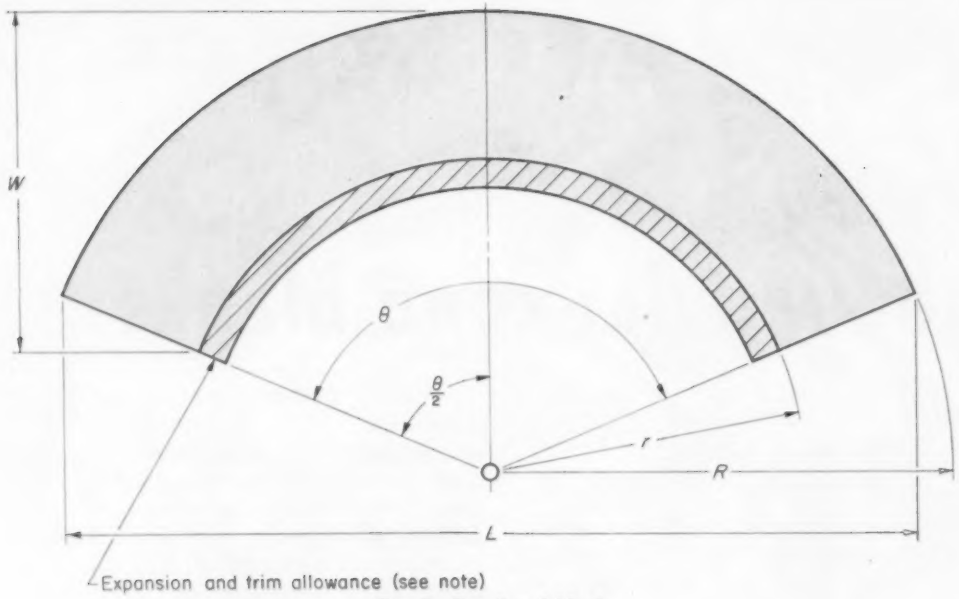


Fig. 2. Developed blank.

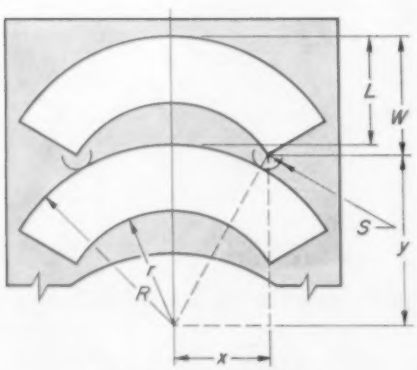


Fig. 3. Nesting of blanks.

of thin stock the allowance should be ⅛-inch minimum. Distance between blanks, l is given by

$$l = W + y - R \quad \ldots\ldots (9)$$

where

$$y = \sqrt{(R + s)^2 - x^2}$$

and

$$x = r \cos \frac{\theta}{2}$$

EXAMPLE: Given $D = 35.00$, $d = 30.00$, $H = 14.00$, $t = 0.090$. Substitutions in the equations gives values for the blank dimensions. All dimensions are in inches.

$$\tan \alpha = \frac{D - d}{2H} = \frac{35.00 - 30.00}{2(14.00)} = 0.1785714$$

$$\alpha = 10^\circ\ 7'\ 29''$$

$$n = t \cos \alpha = 0.090(0.9844) = 0.0886$$

$$D_{np} = D - n = 35.00 - 0.0886 = 34.9114$$

$$R = \frac{D_{np}}{2 \sin \alpha} = \frac{34.9114}{2(0.1757916)} = 99.2977$$

$$r = R - \frac{H}{\cos \alpha} = 99.2977 - \frac{14.00}{0.9844274} = 85.0762^*$$

$$\theta = \frac{D_{np}\ 180}{R} = \frac{34.9114(180)}{99.2977} = 63^\circ\ 17'\ 2''$$

$$L = 2(R \sin \frac{\theta}{2}) = 2(99.2977)\ (0.5246093)$$

$$= 104.1850$$

$$W = R - r \cos \frac{\theta}{2} = 99.2977 - (85.0762)\ (0.8513431)$$

$$= 26.8687^*$$

$$l = W + y - R = 26.87 + \sqrt{(99.42)^2 - x^2} - R$$

$$= 26.87 + 99 - 99.30 = 26.57$$

*When material is allowed for expanding, r and W change. For a 0.25-inch allowance; r becomes 85.0762 — 0.25, or 84.8262, and W changes to 26.8687 + 0.25 cos $\theta/2$, or 27.0815.

astme in action

Space experts Wernher Von Braun (left) and Herschel Brown head engineers' program at Santa Clara Valley, Calif. Story on Page 122.

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Brought together by the ASTME seminar in Detroit, experts on high energy rate forming discuss the future of their rapidly advancing field. This distinguished group served as speakers and moderators for the opening program on the Society seminar schedule this year.

Space-Age Forming Launches Seminars

HIGH ENERGY RATE FORMING, or HERF, launched the Society seminar series this year in true Space-Age fashion. During a two-day program in Detroit, a panel of 13 leading engineers and scientists highlighted HERF's vital role in the nation's defense industries as well as its increasing applications in general industry. Attending this opening seminar were 79 registrants from Canada and all parts of the United States.

Ronald A. Carlson, assistant chief of fuel element development at Battelle Memorial Institute, told the group that explosive forming is a necessity for aerospace developments because the size, shape and material of many of the needed fabrications make them impossible to form by any other methods.

According to Floyd Cox, manager of manufacturing R&D at Ryan Aeronautical Co., more than 100 companies are now engaged in explosive-forming research, development and production. The advantages of this method of forming, he said, are larger parts, higher pressures, lower costs and combination of parts. As limitations of the process, he listed size of available sheet material, size and equipment necessary to make tooling and methods of handling the large dies and parts.

Pneumatic-mechanical high energy rate forging machines have overcome two main hurdles, reported Joseph M. Palsulich of Western Gear Corp. First, the equipment has been refined to the point where it can be used on a production basis for the forging of a wide variety of materials. Secondly, the process has demonstrated that it can overcome many of the urgent problems which face the metalworking industry of today.

Other evidence that HERF has come out of the research laboratory into the realm of production was given by Thomas S. Riordan of the Bendix Utica Div. In one year, he said, his company produced over 18,000 successfully formed parts, using the Dynapak pneumatic-mechanical forming press.

Louis Zernow, director of research at the Ordnance Div. of Aerojet-General Corp., brought out the possibility of automated explosive forming. Another seminar speaker, Robert Felts of Electrodynamics of Michigan, noted that Russia has already automated electrohydraulic forming in the pot-and-pan industry.

HERF has not yet demonstrated a capability for mass production methods, said Alvin M. Sabroff, assistant chief of metalworking research at Battelle. However, he added, mass production will come as energy-sources and tooling are improved, as materials-handling means for high production rates are developed and as general knowledge of these forming methods increases.

Sabroff emphasized that, before much wider applications of HERF can be achieved, there must be a much greater effort along R&D lines, especially in the areas of process design and metallurgical effects. "In other words," he said, "old rules of metalworking do not apply to high energy rate forming, and we must find out what the new ones are."

Also on the program was a discussion of forming with explosive gas mixtures by Richard E. Lingen. The Boeing engineer explained that this process enables close control of the reaction and is capable of faster production rates than conventional high explosive forming. On the other hand, gas mixtures over approximately 15 atmospheres are not practical and hot forming by this method does not appear feasible.

Chairman of the seminar was Joseph J. Gabrick, chairman of Detroit Chapter 1.

Manufacturing Engineers

Pace Space Race

TOOL AND MANUFACTURING ENGINEERS are making major contributions to man's conquest of outer space. More than 3000 ASTME members are working directly on the manufacture of advanced aircraft, rockets and missiles, and thousands more are producing essential electrical, hydraulic and mechanical components for guidance systems, launching systems and even space frames.

Well aware of all this, the tool and manufacturing engineers in Santa Clara Valley, Calif., recently got together with other engineers in their community to present a superlative Space-Age program featuring the top man in the field today, Wernher Von Braun, director of the George C. Marshall Space Flight Center in Huntsville, Ala.

An audience of 2800 turned out to hear Dr. Von Braun speak for an hour-and-a-half on America's present space carrier vehicles and those to come.

As the rocket expert discussed the tremendously big propulsion systems in store for this country, the members of ASTME's Santa Clara Valley chapter took special note of the manufacturing problems such systems will pose for tool and manufacturing engineers. The rocket for the Saturn space vehicle will have 1.5 million pounds of thrust, said Dr. Von Braun, and will be capable of orbiting a 10-ton satellite and of putting a half-ton payload on the moon.

Concerning the race for space, Dr. Von Braun stated that it is impossible to label either Russia or the U. S. as the out-and-out leader. While the Soviets are ahead in rocket propulsion, he pointed out, this country seems to be 'way out in front in communications satellites.

Besides Dr. Von Braun, two other prominent figures in the space field took part in the program. Introducing the guest speaker was Herschel J. Brown, vice president and general manager of the Missiles and Space Div. of Lockheed Aircraft Corp.; and toastmaster for the evening was Earl S. Herald of the California Academy of Sciences. Dr. Herald is also host for the San Francisco TV series "Science in Action."

Shown on this month's News cover are Brown and Dr. Von Braun discussing the status of U. S. space efforts. The cover decor—an enlarged view of the southwestern portion of the waxing crescent moon—is from a lunar photograph taken with the 36-inch refractor at Lick Observatory, University of California.

Programs like that of the Santa Clara engineers make clear the necessity of new advances in manufacturing processes and methods. These advances may be just the needed extra-energy that will help America to be the first to spurt across the space line and win.

And in the long-term quest for ways to reach the moon and stars, tool and manufacturing engineers, like those in Santa Clara and all the other ASTME chapters, may be America's biggest asset.

Officer-Committee Meeting Continues To Be Success

THE SECOND JOINT MEETING of ASTME's officers and committees, held Sept. 22-24 in Detroit, continued to improve communication among Society leaders. As in July, at the first combined meeting, the committees held individual sessions for a day-and-a-half, then the chairmen reported to the officers on the plans of their respective groups.

The September meeting, however, took a further step in improving Society communications. All committee chairmen and representatives of the Headquarters staff were present for the committee reports to the officers. In this way, the entire group is kept up to the minute on Society activities.

Committees participating in the three-day meeting included: Editorial, Chapter Programs, Constitution and Bylaws, Education, Engineering Conferences, Finance, Membership, Public Relations, Standards and Technical Publications.

This is the first in a new series of articles designed to familiarize members with the important work of ASTME committees. Under the guidance of the officers and directors, these committees plan and direct every Society activity.

At this year's first session of the Public Relations Committee, Chairman L. A. Wacker (standing) outlines the five vital areas of Society communication. Studying the chart are (left to right) Headquarters PR Director E. L. Koester and committee members C. K. Hay, J. E. Wilson, H. E. Kuryla and J. F. Wrobel.

ASTME's Communications Experts:

The Public Relations Committee

By Patricia A. Libel, Associate News Editor

PUBLIC RELATIONS is a much used term, often so nebulously defined that one begins to wonder if America is spending $2 billion a year on hidden persuasion or on the practice of the Golden Rule. What is glibly referred to as "social engineering" or "image building" on Madison Avenue is regarded on another avenue as just doing good things and letting people know about them.

In ASTME, public relations has no fancy names, no vague connotations. It is simply communication —effective communication with the public to present the Society in its best light at both the national and local levels.

Such communication is directed by a five-man committee of Society members who, because they know the organization and know the field of tool and manufacturing engineering, determine the policies put into action by a full-time Headquarters staff of four professionals. Assisting the committee in its direction of communication at the local level are the chapter public relations committees of every ASTME group throughout the United States, Canada, Australia, Mexico and the Philippines.

Chairman of the Public Relations Committee this year is Lawrence A. Wacker of Milwaukee chapter, now serving his third term on the committee. Henry E. Kuryla of Hartford chapter and Charles K. Hay of Houston chapter are both serving their second year with the group. New members are Joseph F. Wrobel of Detroit chapter and John E. Wilson of Ithaca chapter. The ex-officio member is President Wm. Moreland.

Through the various communication media, the PR Committee brings to the attention of five specific audiences—the membership, professional societies, educational institutions, industry and the general

public—the Society policies, procedures and activities that will be of most interest to each group. This, of course, involves the planning of detailed promotional campaigns for ASTME books, THE TOOL AND MANUFACTURING ENGINEER, the Creative Manufacturing Seminars, the Tool Expositions, the Annual and Semiannual meetings, the Honor Awards, and the Society's research programs.

But over and above promotion of existing activities, the committee frequently initiates programs to improve communication in areas where careful study has determined the need. This year PR undertakings will be concentrated in three directions, as outlined in the committee's ambitious progress-plans presented to the Society officers last July:

- Increase involvement of industrial, educational and government leaders in Society activities.
- Produce at least one prestige program to result in noteworthy booklet to distribute to these leaders.
- Expand chapter public relations participation through a series of clinics.

Past committee activities have laid firm groundwork for accomplishing the first of these objectives. Last year, for example, leaders of industry, education and government who had visited Iron Curtain countries were brought together by the PR group for two ASTME-sponsored programs on the race for manufacturing supremacy—one at Columbia University in New York and the other at the University of California at Los Angeles.

In realizing their second plan—the production of a noteworthy booklet—committee members will again draw on past experience. About a year ago the group published a brochure on the engineer's responsibility to his community, containing excerpts from a Detroit presentation on the same subject. Enthusiastically received among top industrial management, the booklet proved to be an excellent ambassador for the Society.

The third PR program—chapter clinics—is already successfully underway. On Sept. 9 in Dayton, Ohio, this year's first Communications Clinic was attended by 67 officers and committee chairmen from 13 chapters in the Dayton area. Wacker and Wrobel represented the PR Committee.

During seven workshop sessions, registrants discussed two-way communication between chapters and Headquarters as well as local communication with members, prospective members, industry and the community. In addition, four separate panel discussions explored the most important tools of chapter communications—membership, programs, education activities and chapter bulletins.

Clinics like the Dayton program are of prime importance to over-all Society public relations, according to Chairman Wacker. "Good PR," he says, "cannot be effected by only one committee. It is dependent on the sum total of impressions created by the individual activities of each of the 174 ASTME chapters and each of the 41,000 members."

Society Receives Research Award

On behalf of ASTME, Vice President David A. Schrom (right) accepts the 1961 Presteel Award from Carter C. Higgins, president of Worcester Pressed Steel Co.

IN RECOGNITION of the Society's outstanding contribution in enlarging the field of metal stampings, the Pressed Metal Institute has presented its 1961 Presteel Award to ASTME. Vice President David A. Schrom accepted the honor—a statuette and certificate—at the annual banquet of the Institute on Sept. 27 in Point Clear, Ala.

The eighth winner of this award, ASTME holds an impressive record of service in the metal stamping field. Its contributions in original research and the dissemination of information have been administered by the Metal Stamping Project Committee, organized in 1955 by the ASTME Research Fund. During the past six years, over 100 representatives of industry have served on the main steering committee and its subcommittees. Assisted by grants from industry, the project committee has sought to advance knowledge of the metal stamping process in two important ways.

To increase the basic knowledge of the science, a research contract was placed with Syracuse University and the results of the Syracuse work were subsequently published in two ASTME Research Reports. To improve the availability of existing knowledge in the field, the committee has issued a series of seven Research Reports and published several magazine articles.

". . . Current fears regarding automation's possible ill effect on employment are utterly unwarranted. On the contrary, automation promises to increase employment no less certainly than has every advance in industrial progress."—D. H. Connell

Canadian Speakers Pinpoint

Manufacturing Economies

IF INDUSTRY AND LABOR would stop assuming that inflation is inevitable, increased productivity could be translated into lower prices which increase everybody's real wages and improve everybody's standard of living, said David H. Connell at the Society's Semiannual Meeting last week in Toronto.

Speaking during the first of the meeting's three Techtours, Connell explained that industry, assuming a continuing trend toward higher and higher wages, has refused to recognize in increased productivity a valid reason for cutting prices. Likewise, labor, assuming higher and higher prices, has repeatedly sought wages higher than increased productivity could justify, he said.

Connell, who is plant manager of the Canada Cycle and Motor Co., Ltd., told the ASTME group of his plant's recent reorganization and the resulting manufacturing economies. Costs were reduced in every phase of plant operation, he reported, and all economies derived essentially from improved methods of handling materials.

Inventory and Enameling Costs Cut

The introduction of an ABC system of inventory controls—under which all items are classified according to cost and the quantity used—diminished the plant's capital outlays on inventory and saved space, carrying charges, insurance, extra handling, inventory depreciation and much paper work. Another innovation, pointed out Connell, was the electrostatic enameling installation that replaced obsolete dip-coating facilities used in the manufacture of bicycles. The new system increased productivity, reduced paint consumption and simplified color changes.

To integrate each product division—bicycles, children's vehicles, and ice skates and hockey boots—virtually every item of manufacturing equipment in the plant had to be relocated. This involved moving five acres of machine tools and processing equipment, without curtailing production.

According to Connell, the total transformation of the plant was accomplished with a minimum of friction between management and labor. "We have concluded," he said, "that the more effectively productive a man is given to feel himself, the happier he becomes. Quick to lay hold of a sense of achievement, man is prone to become proud of a place on an up-and-coming team."

Another Semiannual Meeting speaker, S. R. Palmer, manager of the Tool & Gauge Div., John Bertram & Sons Co., Ltd., stressed the engineer's responsibility for cost of manufacture. Due to present economic conditions, he warned, tool and manufacturing engineers must become cost-conscious.

"Look at all your operations and the operations that will be affected by your actions, your designs, and your products," he urged. "Value evaluate them. The object is equal performance at lower cost."

Enumerating the important qualities that the tool and manufacturing engineer should bring to his job, Palmer headed the list with imagination. Ingenuity came next and, thirdly, a quality "that makes a man keep driving for an objective, that enables him to critically review his present methods and accept change when he sees the need for it."

"Profit is not a dirty word. Without it none of us has any security, without it we cannot re-equip our factories or develop new techniques."—S. R. Palmer

RICHARD A. WHITNEY (left), Toronto chapter member and president of Cincinnati-Churchill, Ltd., congratulates STEVE KRAR on his completion of a machine tool technology course given by The Cincinnati Milling Machine Co. in Cincinnati last summer. A member of Grand River Valley chapter, Krar is one of 13 Canadian industrial arts teachers who participated in the tuition-free training program. Academic credits were granted the teachers upon completion of the course's 96 hours of classroom work and 64 hours of on-the-job training at the plant.

Members in the News

H. R. ROBERTS, Hamilton District chapter, has joined Neo Machine Ltd., as shop foreman. In this position he will be responsible for all machining operations of the Hamilton, Ont., firm.

ALBERT UNDERWOOD, JR., has been named plant manager of the engine plant, Windsor manufacturing operations, Ford Motor Co. of Canada, Ltd. Formerly quality control manager at Ford's Windsor manufacturing operations, Underwood is the Society treasurer and a member of the Board.

A. O. SCHMIDT, chief engineer, metalcutting research, Kearney & Trecker Co., has requested that funds accumulating in his name at Marquette University college of engineering be used to establish the O. W. BOSTON Research Fund for Advancement in the Fields of Metal Processing. Prof. Boston retired two years ago as professor and chairman of the department of metal processing at the University of Michigan, Ann Arbor. Dr. Schmidt is on the faculty at Marquette. Both men have received the ASTME Gold Medal, awarded each year for outstanding service through published literature dealing with tool and manufacturing engineering.

ATHEL F. DENHAM, member of ASTME since 1939 and former chairman of the Society's Public Relations Committee, was recently awarded an honorary degree in mechanical engineering by Stevens Institute of Technology. He is president of the Denham & Co. advertising agency in Detroit.

Fixture Design Book Due in January

USHERING IN THE NEW YEAR will be a new ASTME publication on workholding principles and designs for all classes of machining, assembly and inspection. Titled *Handbook of Fixture Design*, the volume is due off the presses next January.

According to the Society's Technical Publications Committee, the book will give comprehensive coverage of workholding means and methods. It will be practical in applications, says the committee, and theoretical in principles.

The prime purpose of the book—to make the experience of many skilled designers available to all—is realized in the work of 58 contributing authors. Comprised of both ASTME members and nonmembers, this distinguished author-group includes representatives of 12 different Society chapters, 8 states and the province of Ontario in Canada.

A glance at some of the individual contributors' professional titles—chief tool engineer, LeTourneau Westinghouse Co.; tool design supervisor, Caterpillar Tractor Co.; senior tool designer, Ford Motor Co. of Canada; tool analyst, IBM; instructor, department of mechanical engineering, University of Illinois; director of research, The DoAll Co.; and president, Valley Engineering Co.—evidences the qualifications of the authors as well as the scope of the book.

Like all ASTME publications, the *Handbook of Fixture Design* will be made available to Society members at a special discount price.

The Society adds to its ranks a new—and enthusiastic—chapter as President Moreland (center) presents the Columbus, Ind., charter to Chairman Burton. On the right Director Darger displays an ASTME baby bottle symbolizing the birth of Chapter 174.

President Charters Columbus Chapter

COLUMBUS, Ind.—With Society President Wm. Moreland officiating, Columbus, Ind., recently became the 174th chapter of ASTME. From every point of view, the chartering ceremony was an enthusiastic and successful beginning for the new 82-member group.

Attending the dinner meeting were 110 persons. The guest list included representatives from three major Columbus industries—Arvin Industries, Cummins Engine Co. and Hamilton Cosco, Inc.—and from three ASTME chapters—Indianapolis, Evansville and Muncie. Also present were Society Director Carl Darger and Columbus Mayor Welmer.

As speaker of the evening, President Moreland presented a timely talk on the present technological revolution. ASTME's contribution to this revolution, he said, is the banding together of engineers to share the technical know-how it will require to keep the United States ahead in the progress of the world.

Chairman of the Columbus chapter is Dudley K. Burton. Other officers who will guide the new group during its first year are: Ray W. Fortmeyer, first vice chairman; William J. Gardner, second vice chairman; John J. Ingellis, secretary; and Ronald L. Gilbert, treasurer. —*Elden Healey*

Ithaca Experiments with Human Engineering

ITHACA, N. Y.—Starting out the fall with a new look in chapter programs, Ithaca members put the spotlight on human, rather than tool and manufacturing, engineering. The speaker, Stanley Davis of the General Electric Advanced Electronics Center, demonstrated his subject with an eggbeater from yesteryear and another of modern design. One was engineered for ease of human handling; the other was designed to do the work better but with less ease of handling.

Next, Davis divided the members into groups and asked them to list five things they would like to change in the automobile. Keeping in mind safety, comfort and economy, the groups came up with scores of suggestions—proof that there is plenty of room for human engineering. —*G. K. Lamb*

Two Past Directors Die

Headquarters recently received word of the death of Otto R. Reller and Edward J. Berry, both past members of the Society's board of directors. The first chairman of Tri-Cities chapter, Reller was vice president in charge of production and director at Moline Tool Co., Moline, Ill. Berry, who served on the Constitution and Bylaws Committee for eight years, was a past chairman of Little Rhody chapter. For his outstanding service to the Society, he received the ASTME Merit in 1959.

special events

ASTME Seminar "Prototype and Short-Run Tooling Methods"	Nov. 8-9 1961	Belmont Plaza Hotel New York, N. Y.
ASTME Seminar "Electric Machining and Forming"	Dec. 6-7 1961	Statler Hilton Hotel Hartford, Conn.
ASTME 1962 Engineering Conference	May 7-11 1962	Statler Hilton Hotel Cleveland, Ohio
ASTME 1962 Tool Exposition	May 7-11 1962	Public Auditorium Cleveland, Ohio

Rockford Celebrates Silver Anniversary

Touring the Sundstrand plant during their chapter's silver anniversary program, a group of Rockford engineers look on as William Fisher (with microphone) demonstrates a two-axis numerically controlled mill.

ROCKFORD, Ill.—To celebrate the 25th anniversary of the issuing of their chapter charter, Rockford members staged an informative program on numerical control at the Sundstrand Machine Tool Div. of the Sundstrand Corp., Belvidere, Ill. Attended by 125 members and guests, the celebration featured a technical session on the numerical control of machine tools and a tour of Sundstrand to see tape-controlled machines in operation.

Two Sundstrand engineers—Carl Erickson and William Fisher—presented the technical talks, then served as guides for the plant tour. Erickson, who is assistant chief engineer of the new products development engineering department, did most of the initial analytical work on the economic feasibility of the use of numerical controls for Sundstrand components. As head of the department for programming tape-controlled machines, Fisher is responsible for all routing and tool and fixture design in this connection.

Another highlight of Rockford's anniversary meeting was the presentation of a certificate of Life Membership in the Society to Edward W. Dickett, first chairman of Chapter 12. In the October issue of TME, he is shown receiving congratulations from Past President H. Dale Long. —*H. W. White*

Engineering in the Underwater Area

LOS ANGELES—Hardly a usual subject for a technical meeting, the evolution of diving equipment proved to be a top attraction with Los Angeles engineers when Del Giudice of Sportsways, Inc., recently spoke to Chapter 27. As Giudice traced the history of deep diving from its beginning to present developments in modern scuba, the members of Los Angeles took special note of the many engineering and manufacturing requirements involved in this interesting field.

After the presentation came an unusual question and answer session—it lasted longer than the original talk. In addition, two short films were shown; one on underwater life in the ocean and another that explained how divers are taught to swim in shark-infested waters. When the meeting adjourned, many members were still too interested to leave. They gathered around the speaker, asking more pertinent questions about diving equipment, valves and design techniques. —*John E. Zetterstrom*

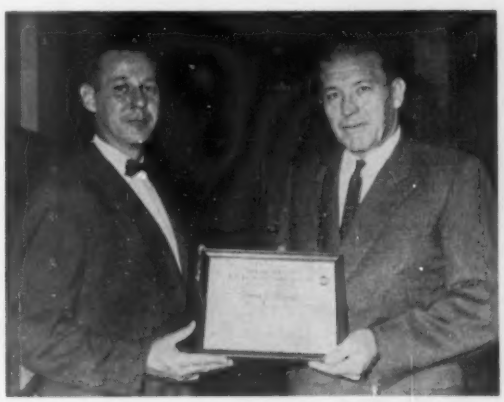
Calling All Gadget Gatherers . . .

. . . Let your clever ideas for ingenious devices work for you—plus thousands of other engineers—in the 1961 Gadget Contest. The competition is sponsored by this magazine to give recognition to exceptionally creative and useful gadgets designed by ASTME members and to uncover for publication gadgets that will solve the everyday manufacturing problems of engineers all over the country.

Recognition for contest winners comes in the form of cash prizes: one first prize of $100, two second prizes of $50 each, four third prizes of $25 each, and many honorable mention awards of books published by the Society.

How to qualify for the prizes? Simple. Send TME's Gadgets Editor a brief description and rough sketch or photograph of your idea. Examples of what a gadget is can be found in the "Gadgets" section of this or any other issue of the magazine. If your entry has practical utility and originality, if it is concisely and accurately presented, it's bound to be selected as a winner by the ASTME Editorial Committee. Submit as many entries as you like, but submit them before December 31.

Editorial Chairman Honored



INDIANAPOLIS, Ind.—James J. Denney (right), past editorial chairman for Indianapolis chapter, and Chairman Robert Mewhinney display the award presented to Denney by James C. Rodgers, chairman of the Society Editorial Committee. Denney was selected for the honor because of his excellent news writing and reporting for TME. —*Loren Hunt*

Reports in Brief . . .

Northeast

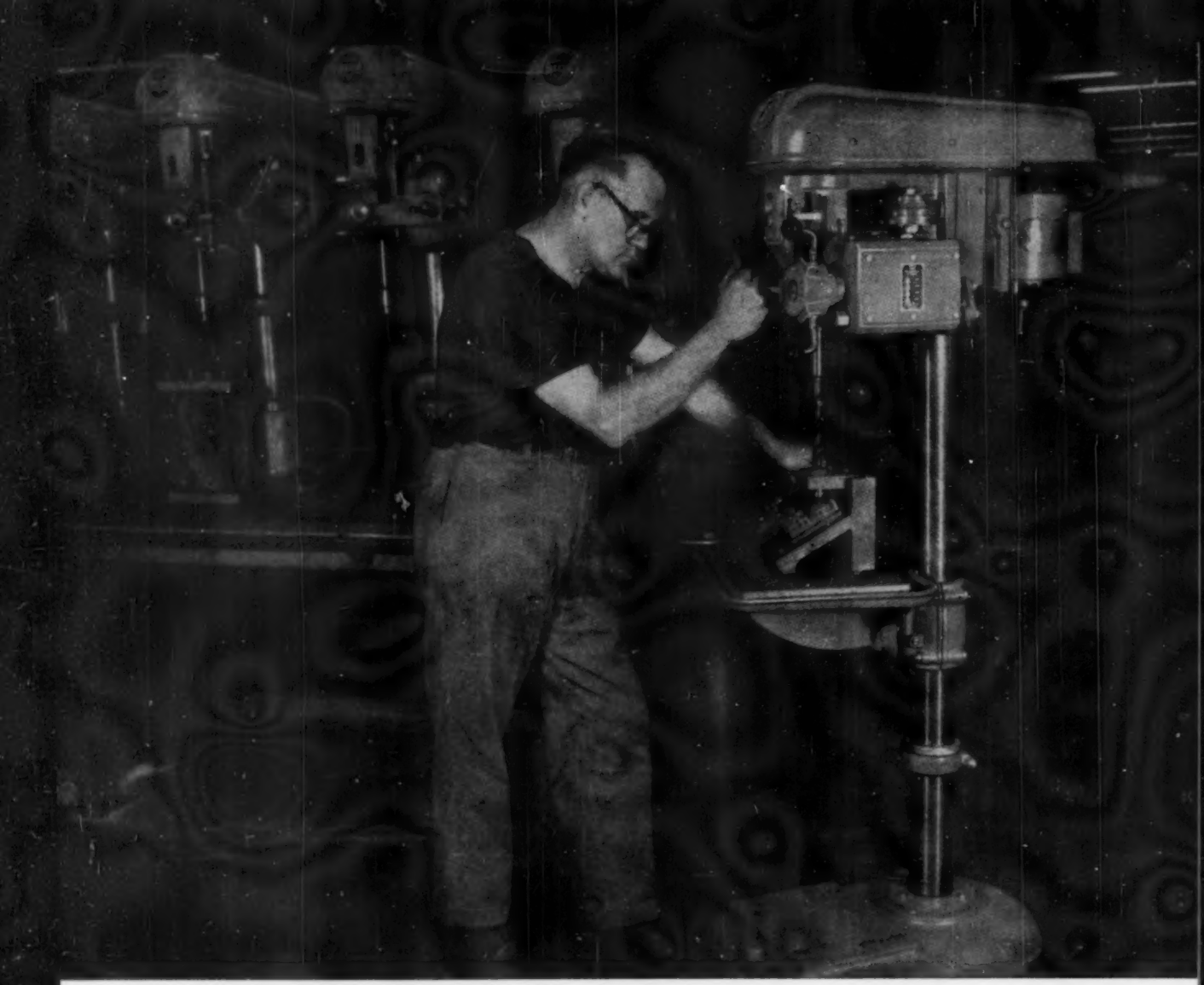
MONADNOCK chapter members recently heard Rev. Fay L. Gemmell talk on an important factor in the over-all coordination of the functions of an industrial plant—the relationship of the employee to supervisory personnel and to other employees. . . . NORTH SHORE chapter speaker Donald Stewart of General Electric Co. discussed explosive forming at a recent meeting. The process is revolutionary, he said, in that large expensive presses are not needed and extreme accuracy can be obtained.

Midwest

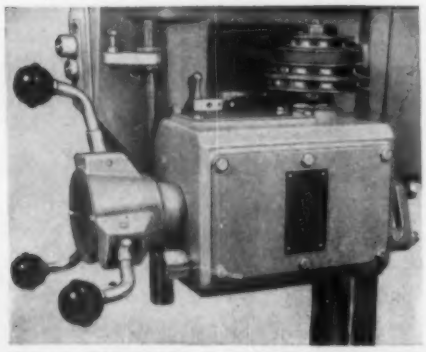
EVANSVILLE chapter's first meeting this fall was highlighted by a description of tool development in the Iron Curtain countries, presented by O. D. Lascoe of Purdue University. Prof. Lascoe attended the Machine Tool Exposition in Posnan, Poland, last year. . . . LANSING chapter recently journeyed to Monroe, Mich., to visit the Enrico Fermi Atomic Energy Plant. After listening to a complete explanation of the plant operations, the group toured the model display room and the plant proper.

West Coast

SACRAMENTO chapter held its 2nd Annual On-Campus Conference at Sacramento State College on Oct. 28. Titled "Research Today—Production Tomorrow," the program began with a discussion of explosive forming by Louis Zernow, director of research, Ordnance Div., Aerojet-General Corp. Others on the speakers' roster included representatives of the Ampex Corp. and I. B. M. . . . SANTA ANA VALLEY members learned about "egg-head" machines when two engineers from Dana Systems explained a new technique of "letting the tool decide." The speakers demonstrated how to compute the breaking point of a tap or drill into the tool so that the machine can automatically stop itself, back out and free itself of the chip in time, and then proceed with cutting the hole.



You can do more with these ALL NEW DELTA 17″ drill presses



Equipped with exclusive new Rockwell Power Feed, these presses can operate in remote control or be interlocked with automation devices. Available as original equipment or as an accessory on every model.

FREE BROCHURE—Complete specifications on the new Delta 17" drill presses and accessories. Write: Rockwell Manufacturing Co., Delta Power Tool Division, 620L N. Lexington Ave., Pittsburgh 8, Pa.

Here's a major engineering advance from Delta to give you increased drilling accuracy, more job flexibility and greater operating economy. You can choose from 76 models that incorporate these up-to-date performance features: New Internal Depth Stop Mechanism, Quick-set Depth Gage, Interference-free Guard and Pivot-type Motor Mount.

These drill presses are completely new—not merely improved or restyled—but actually redesigned to deliver consistent precision operation under the most rugged work loads with little or no maintenance.

Your Delta Industrial Distributor (listed under "TOOLS" or "MACHINERY" in the Yellow Pages) will gladly demonstrate how these 17's can save you dollars, hours and material. Why not call or see him soon!

DELTA INDUSTRIAL TOOLS

another fine product by

ROCKWELL

Use Reader Service Card, CIRCLE 82

Progress in Production

OPTICAL DEVICE CHECKS RIFLE BARREL ROUNDNESS

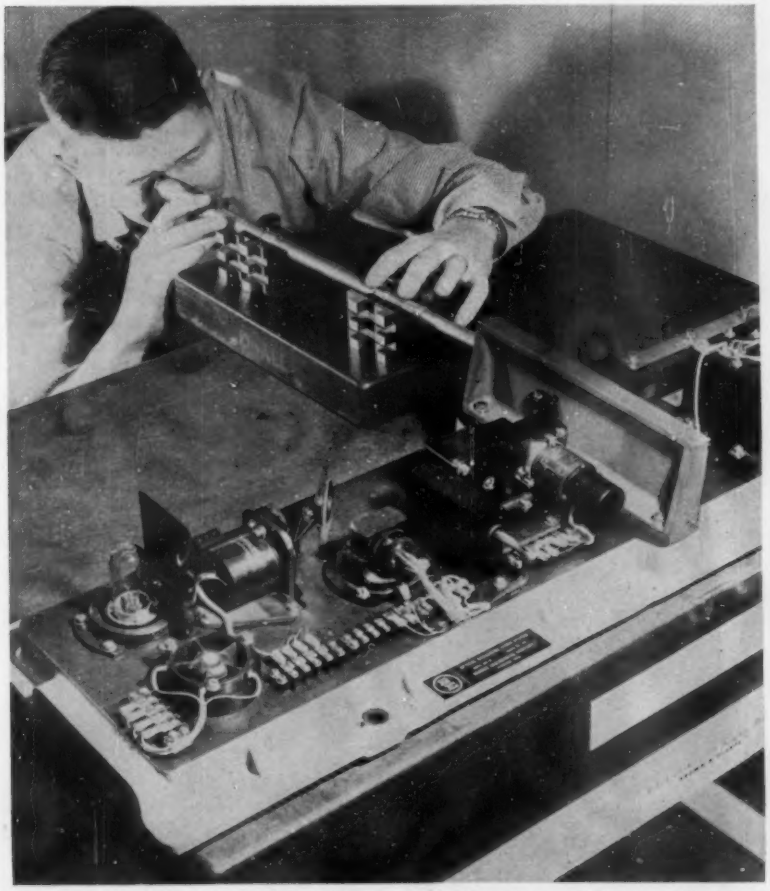
Consisting of a light source and lenses, a beam splitter and a variety of prisms, this optical system can tell straightness of a 0.30-cal rifle barrel to within 0.0003 inch. When installed as part of an automatic measuring system, the checker will plot deviations on a recorder and directly correlate them with their location so that the barrels can be straightened.

A collimated beam of light from a 0.010 x 0.050-inch source passes through a beam-splitting mirror and a projection lens and is focused on the target. The target is a retroreflecting prism pulled through the rifle barrel.

Light returning from the target again passes through the projection lens and is deflected by the beam-splitting mirror onto the dividing edge of an image dissector. Two beams are now formed, both focused by a field lens to land on separate sections of a twin 0.160 x 0.320-inch lead-sulfide detector.

If the beam is perfectly centered on the image dissector, the two spots of light on the detector are of equal intensity. If misalignment exists on the barrel, the beam favors one side of the image dissector. Coupled to a Wheatstone bridge circuit, the resultant error signal is used to turn a servo-driven restoring plate, thus bringing the light beam back to the center of the image dissector. Rotation of the restoring plate is measure by a potentiometer to yield the final output signal, 0.2 volt per 0.001-inch deviation.

The optical device—being designed and built by Barnes Engineering Co., Stamford, Conn., under contract to Associated Engineers, Inc., for use by the Springfield (Mass.) Armory—offers greater speed and higher accuracy. It is expected to test approximately 60 rifle barrels an hour. Also, much less training and individual skill will be necessary to operate the mechanical device with surer results.



A technician sights through a rifle barrel during the preliminary adjustment of this optical measuring servosystem. When completed, the system will check straightness of rifle barrels to within 0.0003 inch.

PLASTIC TOOL MAKES MISSILE PART

Epoxy plastic forming tools are being made and used at Boeing Co.'s Seattle plant in the fabrication of antenna covers for the Minuteman missile. With these tools and the surface casting technique involved, the aircraft company produces six covers a day.

The die is made by casting liquid plastic into the space between a metallic core—rough cast to the general shape of the finished tool—and a model of the working tool. The compression ring is formed by pouring resin into a welded steel shell. To make the punch, plastic is poured into a mold around an aluminum core.

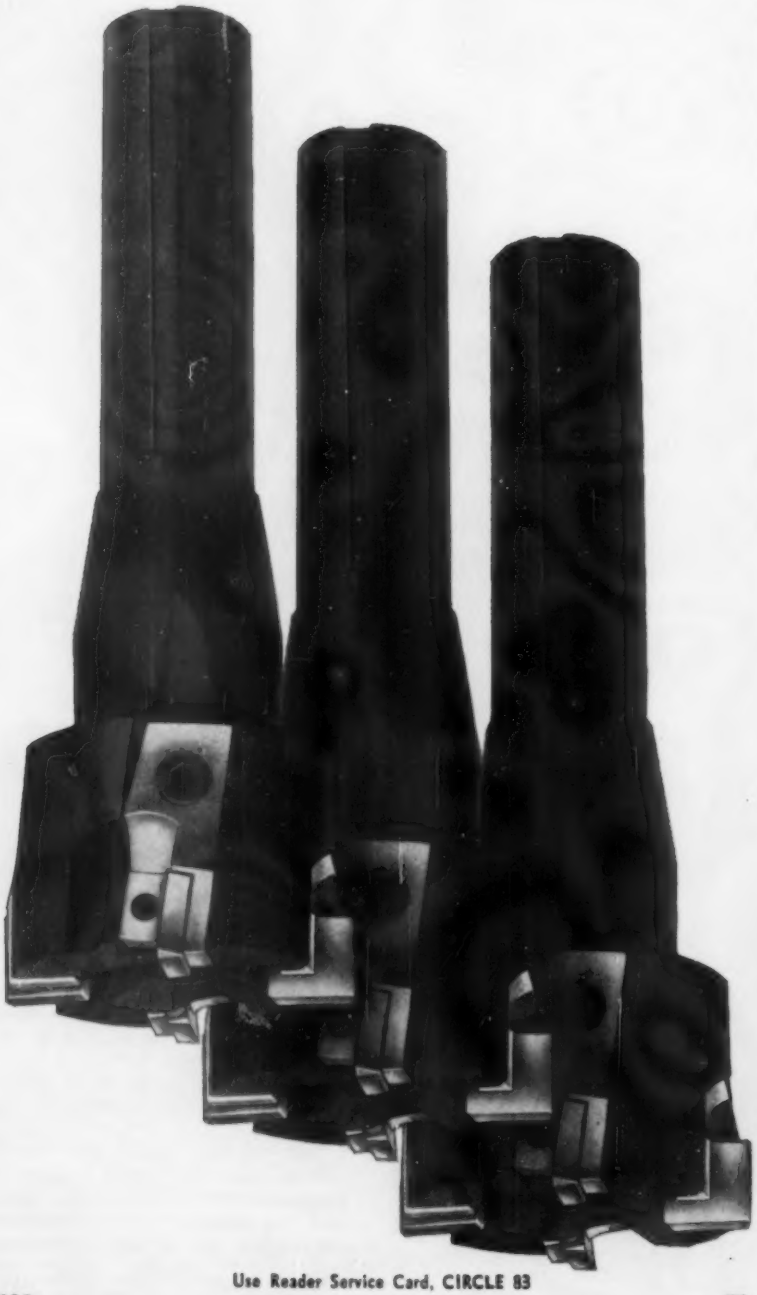
DuPont's Teflon plastic is used for the antenna cover. After it is poured into the mold cavity, the punch is lowered into the cavity by hand. The punch is free floating, held in position by temporary wood spacers. Additional plastic powder is poured in and lightly tamped down around the periphery of the punch.

Next, the wood spacers are removed and the upper platen with its attached pressure ring is lowered. Since the pressure ring is hollow, it slides down over the punch and, as the platen is lowered

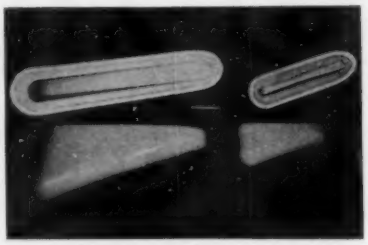
Wider application of the efficiency and economy of Joydex end mills is now possible. They're now available with Bridgeport as well as Weldon shanks. Indexable, throw-away blades provide low cost per edge and fast, easy indexing or replacement. Deep chip flutes increase work capacity. Merely change blades for various rake angles. And . . . *all* Joydex end mills are now priced 30% lower!

Send for details on the *complete* Joydex line of end mills, face mills, and half side mills.

LOVEJOY TOOL COMPANY, INC.
Springfield, Vermont, U.S.A.



Use Reader Service Card, CIRCLE 83



These are two of the plastic antenna covers formed with plastic forming tools. Both exterior and interior views are shown.

further, the punch is picked up and both the punch and ring compress the powder at approximately 1000 psi for 5 min to form the part. Because of the lubricity of the Teflon, the part remains in the die and never adheres to the punch.

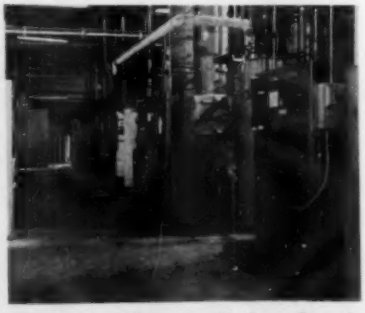
After forming, the parts are supported by a steel male mold and sintered at 700 F. When completed, the parts have a wall thickness of 3/8 inch. Part ejection is effected on one tool by removing half the mold. On the other tool, a thin metal strap is guided down around the part and the part is lifted out by hand.

Plastic materials formulated by Ren Plastics, Inc., are used for the tool.

FURNACE ANALYZERS UP HEAT-TREATING EFFICIENCY

Five major benefits have been reaped by the large jet engine department of General Electric Co. through pinpoint control of furnace atmospheres in heat-treating operations. Application of infrared analyzers has taken many of the question marks out of heat-treating, leading to improved production, better quality control and increased safety.

The installation has contributed to the elimination of expensive cleaning procedures required to remove scale on parts, the elimination of grit blasting of gear forgings after normalizing and



This bank of three purified exothermic gas generators is controlled by infrared analyzers. Results are improved production, quality control and safety.

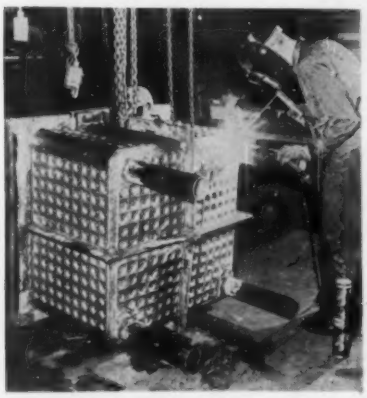
stabilizing, and savings in tooling for gear-machining, since tool life is increased when hard abrasive scale on parts is no longer present. It has permitted maximum utilization of the reducing power of the atmosphere and has removed a possible cause of furnace explosion.

The analyzer, applied to the main gas inlet control valve, prevents erratic gas blends from entering the furnace. Carbon monoxide in the output gas is maintained within a 2 to 2½ percent range. Scale—which is caused by excess water vapor, carbon dioxide, or oxygen, or all three—is avoided by using the analyzer to signal when the carbon dioxide level exceeds 0.2 percent at the scrubbing tower outlets.

Five M-S-A Lira analyzers, designed by Mine Safety Appliances Co., Pittsburgh, are currently in use at the GE plant. Three analyzers maintain a constant combustible content from the gas generator; one controls carbon dioxide content of the output gas; and one serves as a portable dew point analyzer.

DIMPLED JACKET DESIGN REDUCES REACTOR COST

Savings as high as 35 percent in initial cost are leading to the increased use of dimpled jacket construction for reactors. The all-welded jacket can be made of lighter-gage metals than a re-

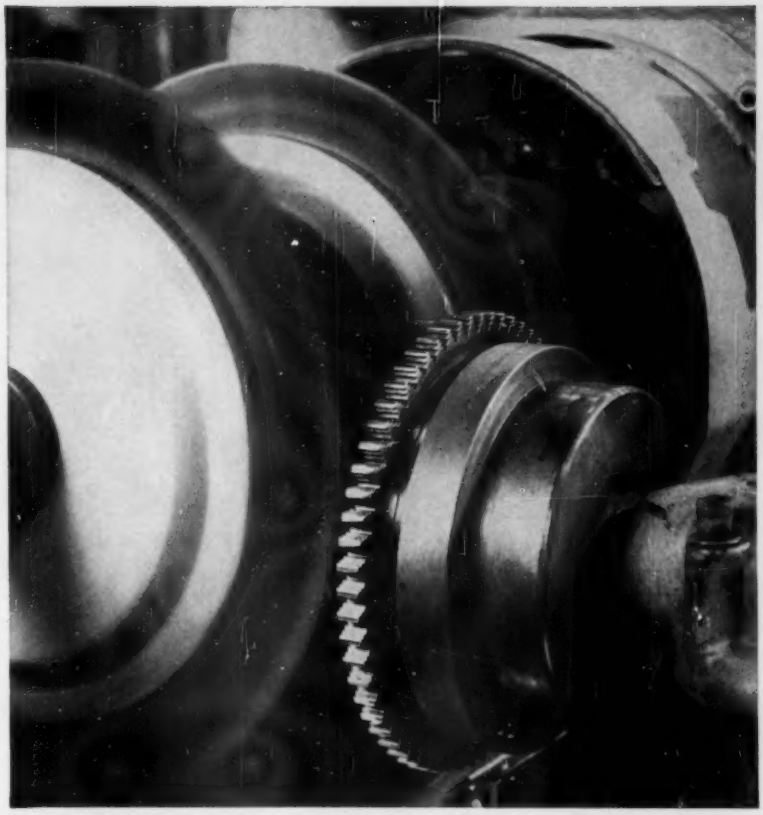


Horizontal and vertical ribs running between the dimples of this reactor add strength and provide maximum heat transfer area. Here carbon steel leg supports are being welded to a completed reactor.

actor of conventional design for meeting the same pressure requirements.

Alloy Crafts Co., Delphi, Ind., includes a rib in the pattern for added strength and maximum heat transfer area. The company uses stainless coated electrodes supplied by Arcos Corp., Philadelphia, for both plug welding and for welding the sheets.

Dimpled jackets can be used for heating vessels of almost any size and shape.



GAS TURBINE DISC DOVETAILS are deburred rapidly, automatically on Osborn 3A Finishing Machine using Osborn 14" Tufmatic® power brushes. Cycle time—floor to floor: 5 minutes . . . *9 times faster than former method.*

COST CUT 90% deburring
with OSBORN power brushing

Before: deburring the 64 dovetails broached on this gas turbine disc was a problem for this major producer of jet engine components. Off-hand filing was slow and costly . . . took 45 minutes per part . . . cost about $5.00 per disc.

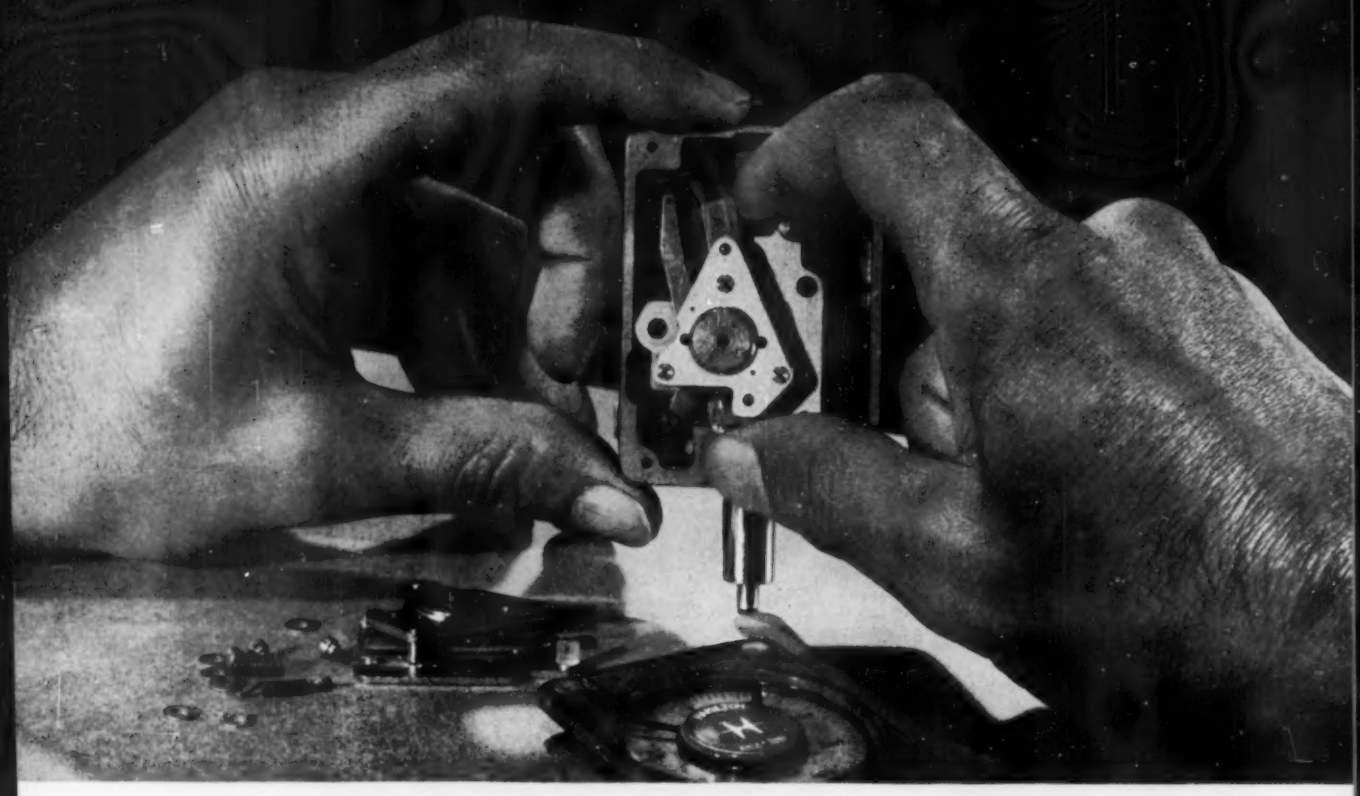
Now: an Osborn 3A Finishing Machine—equipped with two Osborn Tufmatic® power brushes—deburrs the part automatically in just 5 minutes . . . *9 times faster.* Finishing cost is down to 50¢ per part . . . *a 90% cost reduction.* And production quality is consistently higher, more uniform.

Osborn power brushes and advanced brushing methods can help *you* same time and money on metal finishing operations of every description—deburring, cleaning, polishing, precision blending. An Osborn Brushing Analysis—made at no obligation in your plant now—is the first step to savings like these. Write or call *The Osborn Manufacturing Company, Dept. K-70, Cleveland 14, Ohio. Phone ENdicott 1-1900.*

OSBORN

Metal Finishing Machines . . . and Finishing Methods
Power, Paint and Maintenance Brushes • Foundry Production Machinery
Use Reader Service Card, CIRCLE 84

2 minute, $10 replacement



Mark up another benefit of Hamilton Gages. For quick, economical maintenance, Hamilton stocks complete movement sub-assemblies. If your Hamilton Gage needs a repair, you "trade in" the old movement and we'll send you a replacement for $10. A few minutes for installation, then you're off and testing. That's it. No inventory of spare parts. Less down-time. Less manpower tie-up.

Let's talk other benefits. Hamilton's gage repeatability to .00001". Hamilton's light gaging force (2 or 4 ounce) that's adjustable. Hamilton's unique transmission action —*indirect* to gear mechanism—that protects the movement from a heavy force at the spindle end. Hamilton's years of watchmaking experience, so valuable in maintaining the fine accuracy of precision gages. Hamilton's complete line of mechanical and electric gages for post-process inspection or in-process production control.

For free data sheets on Hamilton Gages, write to Dept. 2111, Hamilton Watch Co., Lancaster, Pa. They give full specifications on most items in our line. Or, if you have a special gaging problem, write directly to E. P. Barber, Director of Industrial Products Division.

Kwik-Chek Gages—another precision product of the

HAMILTON WATCH COMPANY

Industrial Products Division, Lancaster, Penna.

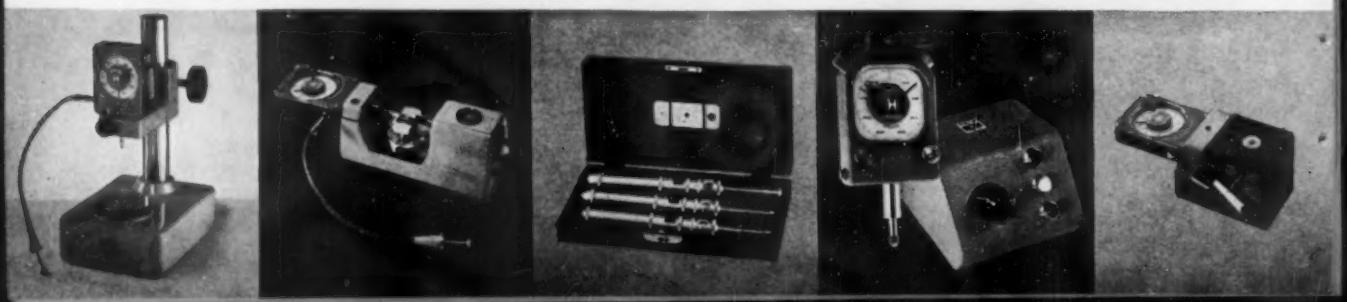
HAMILTON PRECISION DIAL COMPARATOR for applications requiring ultimate in precision. Fine adjustment assures perpendicularity.

HAMILTON HORIZONTAL JAW GAGE for precise measurement of miniature parts. Stage is completely adjustable.

HAMILTON HOLE GAGES replace as many as 700 plug gages. Precision accuracy in range from .025" to .380" . . . increments of .001".

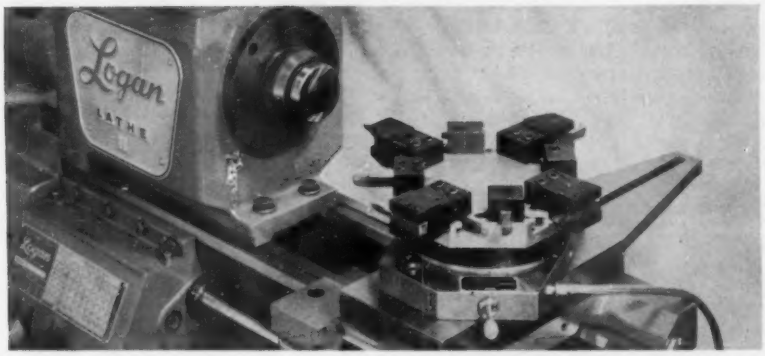
HAMILTON ELECTRIC GAGING SYSTEMS for in-process control. Lights indicate several out-of-tolerance dimensions simultaneously.

HAMILTON SMALL BORE GAGE for measuring small holes. Custom feelers can be supplied for stepped bores, internal grooves, etc.



TOOLS of today

Head Converts Lathes to Chucking Machines



Engine lathes of virtually any make or size can be converted into a chucking machine with this Mag turret head. Its eight-station air-lock turret replaces the entire compound and eliminates the tailstock. It provides rigid tool mounting and repeat indexing within 0.000050 inch. Dovetail toolblocks with an adjusting screw center the tool. All moving parts are hardened, ground and chrome plated. With the head, machining time is cut, difficult jobs are simplified and tooling is speeded up.

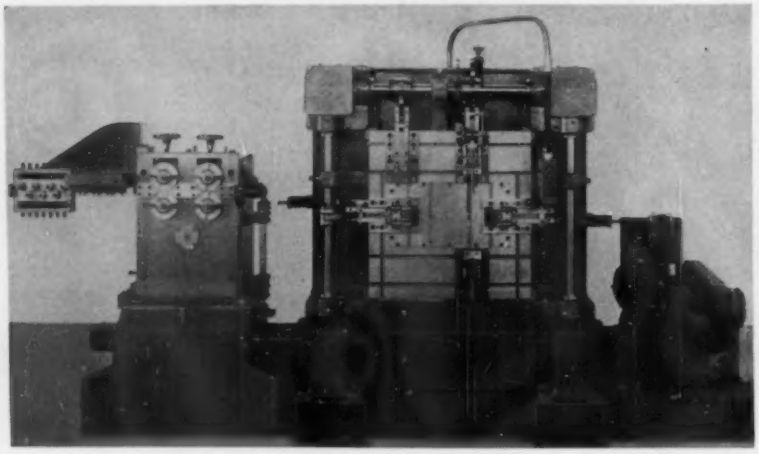
Logan Engineering Co., 4901 W. Lawrence, Chicago, Ill. **Circle 401**

Audio-Visual System Trains Workers

Synchronized sound and slide presentation of how a job must be performed to constantly maintain desired quality standards are provided by the Auto Graphic System. A worker following the audio-visual instructions step by step produces the results of uniform instruction. Basis for the system is a playback unit containing a 35-mm rear projection 8 x 10-inch screen, an amplifier, a tape deck, a speaker, earphones, a volume control, and operator-controlled foot switches. To prepare a program, an outline is made of the slides needed to illustrate the steps of a specific job operation. The slides are then photographed and placed in the slide magazine. Previously prepared commentary is read onto the magnetic tape while the slides are being observed. At the same time, the electronic pulses that change the slides are recorded on the tape. Continuous, demand or timed operation is possible.

L. M. Harvey & Co., Inc., 601 St. James, Syracuse, N. Y. **Circle 402**

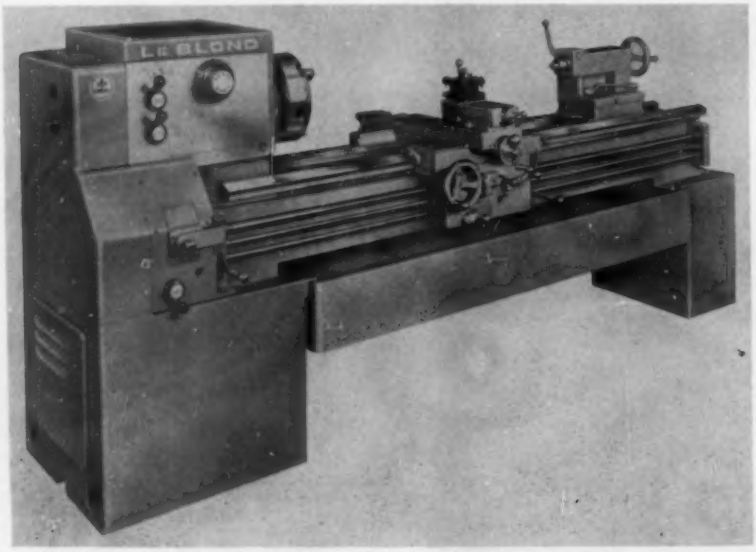
Forming Machine Has 24-Inch Feed Length



The VLW-83 Verti-Slide metal proccessing machine forms wire and strip parts to feed lengths up to 24 inches and at speeds as high as 120 parts per minute. Modular design of the feed, drive, press and forming units provides versatility in producing a wide range of metal shapes and forms. As many as eight interchangeable forming slide units can be mounted at any position in the T-slots at the top, bottom and sides of the large tooling plate. Maximum wire diameter in the machine is 0.250 inch for limited bends and 0.207 inch for unlimited bends. Maximum strip width is ¾ inch. Slide strokes are 2½ inches at top and 4 inches at the bottom and sides.

Torrington Mfg. Co., Torrington, Conn. **Circle 403**

Unit Converts Lathes from Manual to Hydraulic Shift



One feature of Regal engine lathes is that they can be purchased with manual shift and converted later to hydraulic shift. This is possible because of the Servo-Shift package. The package—consisting of a shift-control unit, a crawl speed gear train, a hydraulic motor-pump and a small relay chassis—fits inside the standard headstock to effect the conversion. The package can also be included as original equipment. The lathes are built in four sizes ranging from 13 to 19 inches.

R. K. LeBlond Machine Tool Co., Madison and Edwards Rds., Cincinnati 8, Ohio. **Circle 404**

USE READER SERVICE CARD ON PAGE 167 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Lathes Handle Light and Heavy Jobs

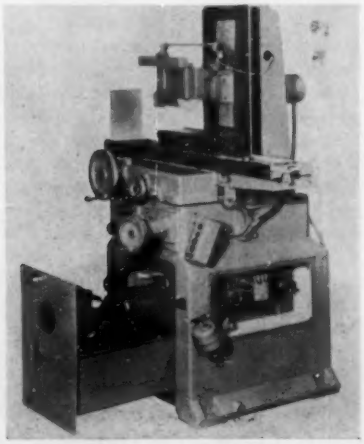
Both the NF 2516 and NF 3220 lathes have 36 spindle speeds in three ranges from 10 to 1300 rpm. They have 60 feed and thread changes with feeds ranging from 0.0045 to 0.269 inch.

Both are rated for 40-hp motors. Spindle speeds are selected through an all-spur gear drive in which only gears and shafts transmitting power are in motion. Model 2516 has a 22¾-inch-wide bed with 25 inches of swing over the bed and 16 inches of swing over the cross slide. Model 3220 has a 24½-inch-wide bed.

R. K. BeBlond Machine Tool Co., Cincinnati 8, Ohio. **Circle 405**

Surface Grinder Has All-Hydraulic Operation

This all-hydraulic surface grinder—Model 618-HYD—has a low-pressure hydraulic power pack with electric valve controls and double pump. The pump provides separate hydraulic circuits for table and cross slide motions. The hydraulic system is also designed



to prevent air pockets from forming in the lines. The operator can switch from power to hand feed and back instantly. He can change to any combination of hand and power to the crossfeed and table without stopping the grinder. Table speed is variable to 125 fpm and crossfeed to 0.250 inch.

Reid Brothers Co., Inc., Beverly, Mass. **Circle 406**

Hard-Facing Rod Assures High Abrasion Resistance

Electric arc application of tungsten carbide hard facing is improved by using solid-core Kenface Arc Rod KT-200. This rod is particularly suitable for large pieces on which gas application is not practical. The rod is composed of a core surrounded by a steel sheath with a coating. It is suitable for either bead or wash pass application and it can be applied by either a-c or d-c reverse polarity current. Deposits range in hardness from R_C 58 to 63 for a single pass and from R_C 60 to 65 for double pass. The rods are $\frac{5}{16}$ inch in diameter and 14 inches long. Coverage of $\frac{1}{8}$-inch thickness is 25 sq in per pound of rod.

Kennametal Inc., Latrobe, Pa. **Circle 407**

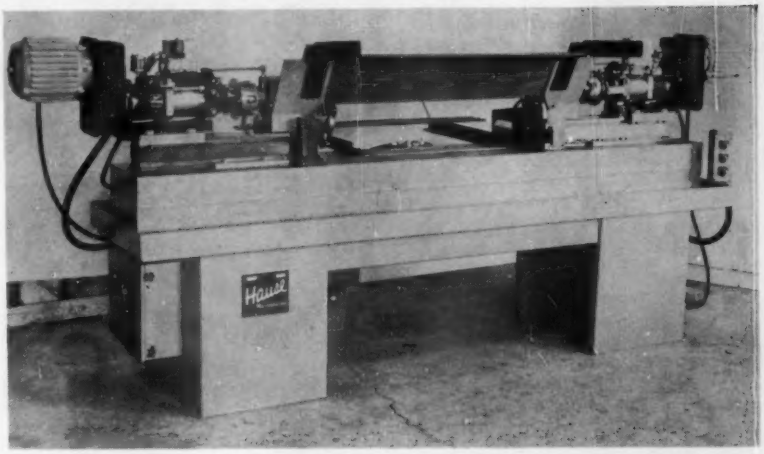
Machine Handles Hard-to-Machine Metals

Shown here is the No. 1 ECM electromechanical machine for removing hard-

to-machine metals at production rates. It has an antifriction bearing for the quill which assures nonstick movement throughout its 22-inch traverse. The machine is protected from the corrosive effects of the electrolyte by a Plexiglass housing. The electrolyte reservoir tank and pump unit supply the necessary electrolyte to the work area. A 7.5-hp motor operates the pump at a maximum of 400 psi at 20-gpm capacity. Power supplies range from 1000 to 10,000 amp.

Cincinnati Milling Machine Co., Cincinnati 9, Ohio. **Circle 408**

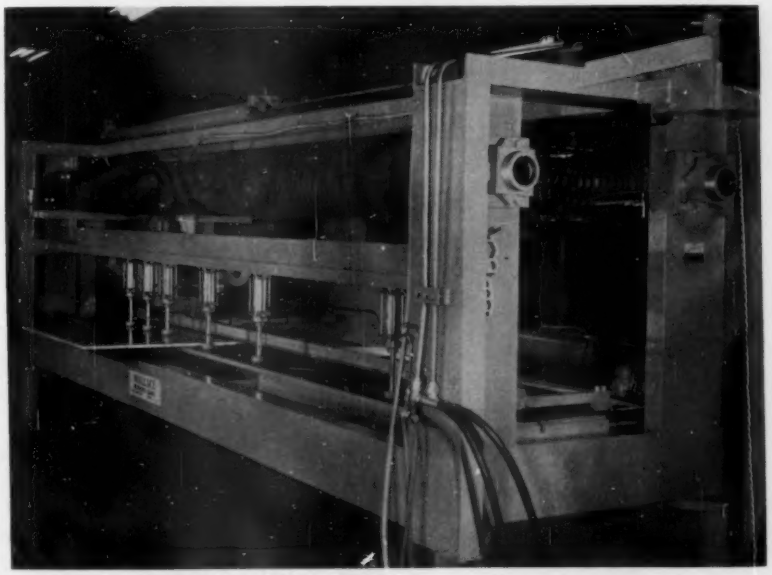
Thread Roller Is Automated



Threads on both ends of steel, aluminum and brass rods are automatically rolled on the Size A Holomatic double-end thread rolling machine at rates up to 3000 parts per hour. Threads in sizes from 6-40 to 7/8-9 as long as 4 inches can be rolled on rods from 5 to 76 inches in length. Air-powered, hydraulically fed units with electric motor driven spindles are used to power the self-opening, end feed type, thread rolling heads. An operator is required only to place rods in the magazine storage arms; the machine loads, locates, clamps, thread rolls, unclamps and ejects the parts. Setups are made by moving the independent fixture-power feed unit assemblies.

Hause Machines, Inc., Montpelier, Ohio. **Circle 409**

Machine Cuts Ferrous, Nonferrous Plate



Both ferrous and nonferrous metals can be cut on this plate cutting machine. When cutting nonferrous metals, its cutting head is locked in position and traversed with the 12-ft width of the bed at variable speed. When used for cutting ferrous metals, the head is unlocked to permit the wheel to sense its way through the cut as it oscillates in its alternating forward and reverse motion through the plate. Change-over from oscillating to fixed cutting can be made in less than 5 min. As an example of its cutting speed, the machine cuts 4-inch aluminum plate at 4 fpm. Its rate when cutting steel plate is 10 ft of 1-inch plate in 6 min. Finish on cuts is from 60 to 100 microinches.

Wallace Supplies Mfg. Co., 1300 Diversey, Chicago, Ill. **Circle 410**

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De-Sta-Co Toggle Action Clamps quickly and accurately position ribs of an aircraft fuselage while skin is applied.

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TOOLS of today

Surface Grinder Is Hand Operated

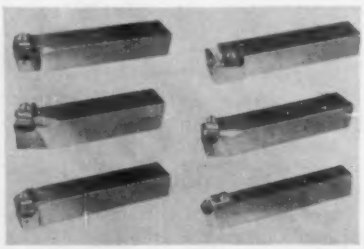
Model TS hand surface grinder comes in two sizes, 6 x 12-inch and 10 x 16-inch. One of its features is its ease of hand operation provided by antifriction bearings under the table. The table traverse handwheel can be mounted on either side of the table and adjusted to position the handle for the

most convenient short stroke operation. The two-speed grinding wheel downfeed handwheel has graduations of 0.0005 inch and a second control with a vernier which reads to 0.0001 inch. A micrometer feed mechanism with reduction gearing permits feeding in increments of 0.0001 inch. The 10 x 16-inch model has crossfeed graduations as small as 0.0005 inch. The 6 x 12-inch model has crossfeed graduations in increments of 0.001 inch. Work height capacity under a full-sized grinding wheel is 12 inches on both models.

Norton Co., Worcester 6, Mass. **Circle 411**

Turning Tools Have Throwaway Inserts

Positive rake angles up to 13 deg with lapped inserts and chipbreakers are features of the Hi-Shear turning tools. They can be used for cutting aluminum, titanium, stainless steel, various refractory metals and other materials. They will also cut work-hardening materials, remove tough



outer skins, and provide clean cuts on relatively soft or tough and gummy materials. They are available in six standard holder styles and 29 sizes for both right and left-hand cutting.

Valenite Metals, Box 205, Royal Oak, Mich. **Circle 412**

Lapping Machine Maintains Correct Abrasive Mixture

Among the features of the redesigned Model 36 Lapmaster is an abrasive distribution system which maintains the correct mixture of compound to vehicle from initial filling to the last drop. Pressure pumping at a constant head assures uniform deposit at the lapping stations. It also provides an adjustable flow control to obtain maximum stock removal. The adjustable worktable can be raised or lowered to be on the same

plane with the lap plate. A remote start-and-stop station provides loading and unloading ease. The model will lap parts of almost any shape, form or material on a production basis within tolerances of one light band or less and uniform microinch finishes of 2 to 3.

Crane Packing Co., 6400 Oakton St., Morton Grove, Ill. **Circle 413**

Power Supply Cuts Welding Costs

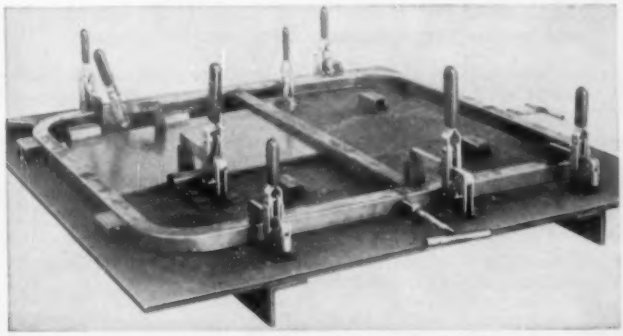
Welding energy of 20 to 225 watt-seconds is stored and released by the Weldpower Model 225B supply to permit 50 to 120 spotwelds per minute. Because the unit operates on a stored energy principle, it uses only a fraction of the power required by an a-c welder. It also stores and discharges the same amount of power for each weld, regardless of line voltage fluctuations. By accumulating energy within 0.5 to 1 sec after each weld and then discharging it in a pulse of a few milliseconds, the supply eliminates burning or oxidation of electrode tips and workpiece while welding.

Raytheon Co., 225 Crescent St., Waltham 54, Mass. **Circle 414**

YOU CAN HAVE PRE-PLANNED PRODUCTION

WITH DE-STA-CO TOGGLE CLAMPS

De-Sta-Co makes it easy to pre-plan production jigs and fixtures right on the drawing board! Detailed tracing templates, in full and half size, can be slipped under a drawing and spotted accurately—saves design time, speeds fabrication! Choose from over 140 models, there's a clamp for every job.



Steel welding fixture with 8 De-Sta-Co Model 267 Toggle Action Clamps holds parts securely during fabrication.

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Wilson TUKON hardness tester

•Wilson TUKON testers make and measure extremely shallow indentations. They are used, for example, by manufacturers of watches, hairsprings, needles and jewels. In laboratories, TUKON instruments test individual crystals or microscopic particles. On any job, they provide these important advantages:

Accuracy—Precision-built TUKON testers give consistently correct results. Loads are applied without friction or impact—Bausch & Lomb optical equipment is standard—vibration is closely controlled.

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American Chain & Cable Company, Inc.
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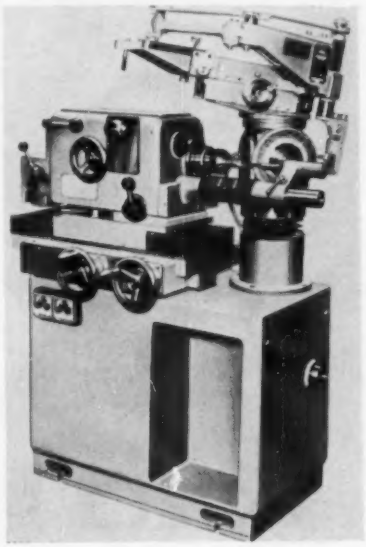
TOOLS of today

Automatic Grinder for Step Tools

Axial and radial relief angles of all step tools can be ground and sharpened simultaneously on this fully automatic grinder. With Model WH-50, the tool follows the relief movements to bring two, three or four cutting edges in contact with the wheel while revolving. The speed of the headstock spindle is

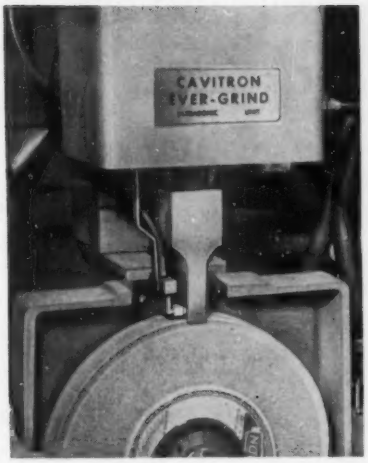


infinitely variable and the axial stroke is variable between 0.086 and 0.236 inch. The radial stroke can be adjusted in four steps from 0.023 to 0.130 inch. The machine has a diamond dresser which can be indexed 90 deg. The grinding wheel can be swivelled around a vertical axis for positioning relative to the workpiece. Workpieces with diameters up to 20 inches can be accommodated.

Eric R. Bachmann Co., Inc., 27-11 41st Ave., Long Island City 1, N. Y. **Circle 415**

Ultrasonic Unit Ups Grinding Wheel Life

Known as the Ever-Grind, this device speeds up the production of any grinding unit by reducing excessive loading on the wheel. It also cuts the need for frequent dressing and downtime. Because it prevents build-up of particles in the open abrasive structure of the wheel, it permits the use of finer and harder grinding wheels. The ultrasonic unit uses a magnetostrictive transducer, driven by a generator operating on 60-cycle line current converted to vibrate the transducer at the rate of



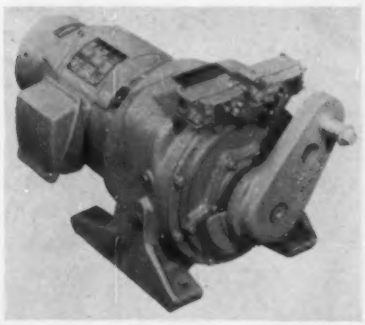
20,000 cps. An aluminum tool, attached to the end of the transducer, is positioned close to the grinding surface of the wheel. As coolant is passed through the tool and on to the surface wheel, thousands of bursting bubbles are induced within the agitated fluid and explode against the grinding wheel as it rotates, simultaneously blasting away any build-up of metal particles and cooling the wheel.

Cavitron Equipment Corp., Long Island City 1, N. Y. **Circle 416**

USE READER SERVICE CARD ON PAGE 167 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Unit Replaces Hydraulic, Air, Steam Cylinders

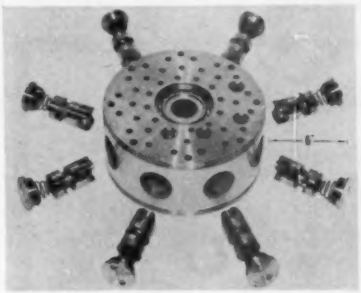
Moduline motocylinders with Guardistor motors for materials handling and other applications replace air, hydraulic or steam cylinders and produce linear motion. The motocylinder is a gear motor with a high-torque, high-slip, intermittent-rated electric motor with an oversize magnetic disk type brake. A crank is mounted on the output shaft and is machined to receive cams which actuate limit switches mounted on the upper part of the gear housing. The cams and limit switches can be adjusted to stop the crankpin at around-the-clock positions. The elements of the motor are connected in a control and warning system which removes the motor from the power source in the event of overtemperature.



Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh, Pa. **Circle 417**

Servomotor Has Wide Low-Speed Range

Uses for the Acradrive 22-cu in. hydraulic motor include positioning drives for machine tools, processing machinery and other specialized equipment which requires extreme precision

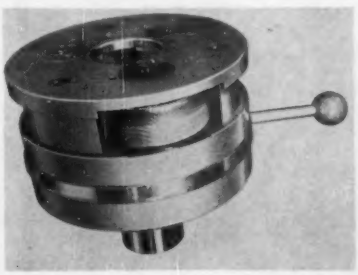


and immediate servo response for orientation, location and speed. This servomotor operates at a maximum pressure of 500 psi, with an effective speed range of 1/60,000 to 500 rpm. It delivers 3.52 in-lb/psi torque at full capacity with 98 percent efficiency and reverses 100-rpm rotation in 0.0015 sec only 0.0006 of a revolution after the signal to reverse. Eight radial pistons drive the motor through needle-bearing rollers acting on a two-lobed cam which encircles the hollow central spindle. The motor can be connected directly to a leadscrew or driveshaft.

Cimtrol Div., Cincinnati Milling Machine Co. **Circle 418**

Head for Thread Rolling Operations

This two-inch thread rolling head rolls diameters from 1¼ to 2 inches UNF and UNC. The No. 16 head is available in a revolving model, for application to threading machines and automatic screw machines using a revolving tool, and a stationary model, designed for turret lathes, hand screw



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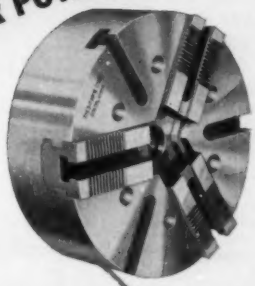
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ROTATING
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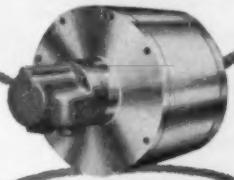
CYLINDERS

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and automatic screw machines using a stationary tool. Both styles are self-opening in operation. Closing the stationary head is done by a reset handle, while the revolving head is closed by a yoke.

Landis Machine Co., Waynesboro, Pa. **Circle 419**

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Tester Attaches to Work Magnetically

Because it attaches electromagnetically to the ferromagnetic material to be tested, the Magnedyne hardness tester can be used in almost any position. It has an adapter shoe which permits testing flat as well as curved surfaces with radii of 2 inches and larger. The portable tester weighs 23 lb and is energized by 115-volt, 60-cycle power supplies. It reads on Rockwell A, B, C and D scales with plus or minus one

point accuracy. It is permanently calibrated by means of a loading mechanism which uses a beryllium copper spring with practically zero hysteresis and drift.

Advance Industries, Inc., P. O. Box 128, South Acton, Mass. **Circle 420**

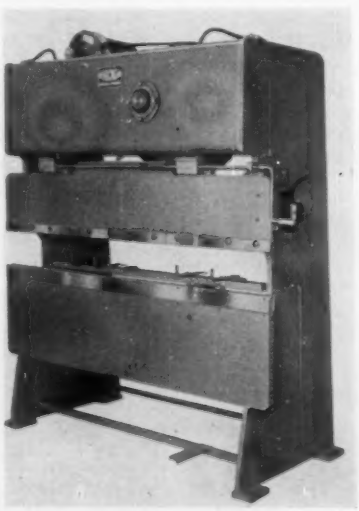
Unit Protects Motors from Overheating

Installed in the end windings or stator slots of electric motors, an inherent protector provides built-in protection against overheating. The CR-124H protector can be applied safely in integral horsepower motors in sizes up to 200-hp, 600-volt. It can be used also as a bearing temperature protector for pumps and motors.

General Electric Co., Schenectady 5, N. Y. **Circle 421**

Press Brakes Handle Light-Gage Metal

Two models of this 25-ton press brake are available for light-gage sheet metal



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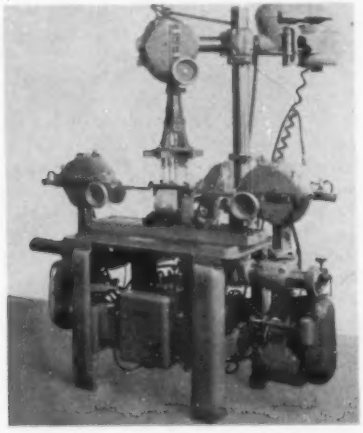
work. Model 265 has an over-all bending length of 72 inches. Its capacity is 66 inches for 14-gage metal and 48 inches for 12-gage metal. Model 285 has an over-all length of 96 inches. Its capacity is 96 inches for 18-gage metal and 66 inches for 14-gage metal. The machines have infinitely variable speed drive from 20 to 50 spm and adjustable rams, and a stroke of 2 inches.

Dreis & Krump Mfg. Co., 7400 S. Loomis, Chicago 36, Ill. **Circle 422**

Machine Drills Work from All Angles

Drilling, counterboring, tapping and reaming operations can be performed simultaneously on a workpiece from almost any angle with this multispindle machine. The Versi-Matic drill has heads that revolve 360 deg both horizontally and vertically either on or under the worktable. Equivalent in size and power to a conventional 17 x 20-inch drill press, the machine performs as a special purpose machine for continuous runs, or it can be rearranged to meet the requirements of other jobs. Each head is individually powered and can be operated by automatic power or manual feed.



Van Norman Machine Co., Springfield, Mass. **Circle 423**

Small Parts Header Has Variable Speed

Instantaneous speed adjustment between 150 and 300 rpm while the machine is in operation is one design change made in the Model "00" solid die, double-stroke cold header. Having wire diameter capacity from 0.012 to 0.070 inch, the machine is especially suited for the manufacture of miniature

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ELDORADO GUN DRILLS are **job and application proved** for all types of complicated and run-of-the-mill drilling jobs... whether the drill or the work turns. They drill holes faster...to a micro finish... **in one single operation,** assuring a more economical answer to more hole problems, than any other drilling method. If you gun drill...your best bet is an ELDORADO! We have a wide range of sizes in STOCK to fit your need...

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ALL SOLID CARBIDE TIPPED
Dias. in every 1/64" increment

Size-Dia.	LENGTH	Driver
.1250" to .5000"	10", 16", 22"—all dias. 28", 36"—most dias.	¾" x 2¾"
.5156" to .7500"	18", 22", 36"	1" x 2¾"
.7656" to 1.0000"	22", 36"	1¼" x 2¾"

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Also custom made Gun Drills in all dias. up to 2" in any length within dia. limits —ON NORMAL DELIVERY

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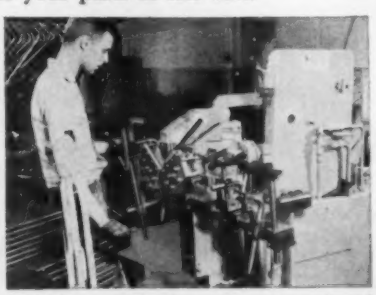
By production bending the "Pines-way," hundreds of metalworking plants are now benefiting from the cost-cutting advantages of cold-bending tubing, pipe, extruded or rolled shapes into parts similar to those above. Parts are produced faster, with smooth, strong bends. This means improved product quality at reduced costs.

A wide range of bending on large or small work, long- or short-run jobs, is easily accomplished by a complete line of standard Pines Bending Machines. Hydraulic power and automatic operation provide maximum accuracy, efficiency, and economy. Find out today, without obligation, how these machines can produce your parts at less cost.

Serpentine coil formed on Pines Rotary Machine at 900 bends an hour with 8% material savings, reduced assembly costs.



Tubular steel furniture frame is produced on a Pines Bending Press at the exceptional rate of over 2000 bends an hour.

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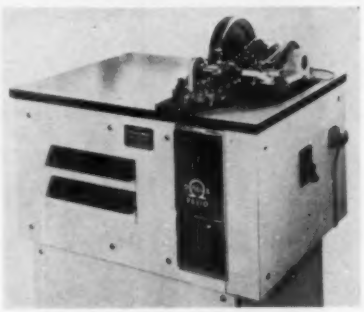
TOOLS of today



parts. A special die block and mechanism allow deep hollowing of rivet shanks in soft materials such as aluminum and fine silver.

REM Sales Inc., P. O. Box 41, West Hartford 7, Conn. **Circle 424**

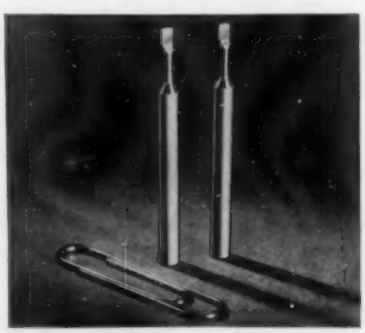
Gages Measure Groove Diameters

Gages in a series of dial indicating groove diameter gages are used for dimensional control of O-ring grooves and for checking out-of-round conditions; tapered or bell-mouthed holes; recesses in blind holes; and inside spherical radii. They are self-centering. Diameters are measured direct, and a slight rocking motion in one direction quickly indicates the minimum reading. Several models in the series measure inside diameters from 0.157 to 4⅞ inches. The gage sets include the gage body with 0.0005-inch-increment dial indicator, an extension, a series of gaging tips, a wrench and a protective case.

Boice Gages, Inc., Hyde Park, N. Y. **Circle 425**

Carbide Tools Bore Small Holes

Designed specifically for jig boring small, close tolerance holes, these solid carbide tools are available in seven miniature sizes for boring diameters from 0.020 to 0.080 inch. The solid

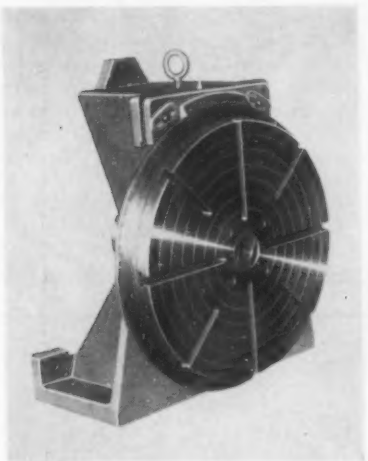


carbide construction adds rigidity. All top rake and relief angles are lapped to mirror-like finishes. The tools are especially suitable for machining miniature parts.

Atrax Co., 240 Day St., Newington, Conn. **Circle 426**

Unit Combines Rotary Table, Angle Plate

This combination rotary table and angle plate can be used either horizontally or vertically for inspection, layout and machining. Its faceplate rotates 360 deg with a radial accuracy by vernier to 5 min visual reading. Its overall table diameter is 18 inches with flatness and runout to 0.0002 inch. Positioning rings and eight T-slots facilitate loading and clamping parts and a two-point table lock assures positive locking.



Machine Products Corp., 6771 E. McNichols, Detroit, Mich. **Circle 427**

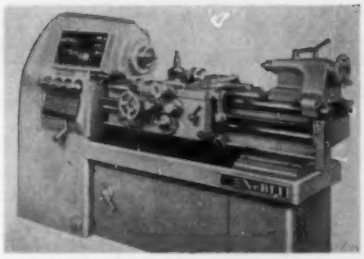
Lapping Machine Handles Large, Small Parts

Both large and small parts can be lapped on a production basis with the 36-inch Gyro-Matic flat lapping machine. It is available in both pneumatic lift and conventional models. With a built-in capacity to obtain optical flatness to 0.0000116 inch, the machine often eliminates secondary steps in production and permits lapped and/or finishing piece parts directly from turning, milling and sanding operations. The unit accommodates virtually any material. It has a dry fluid drive which prevents shock to parts and a three-point bearing contact between steel and workholder conditioned ring. Pushbutton operation and the ability to accept either few large parts or many small parts are other features.

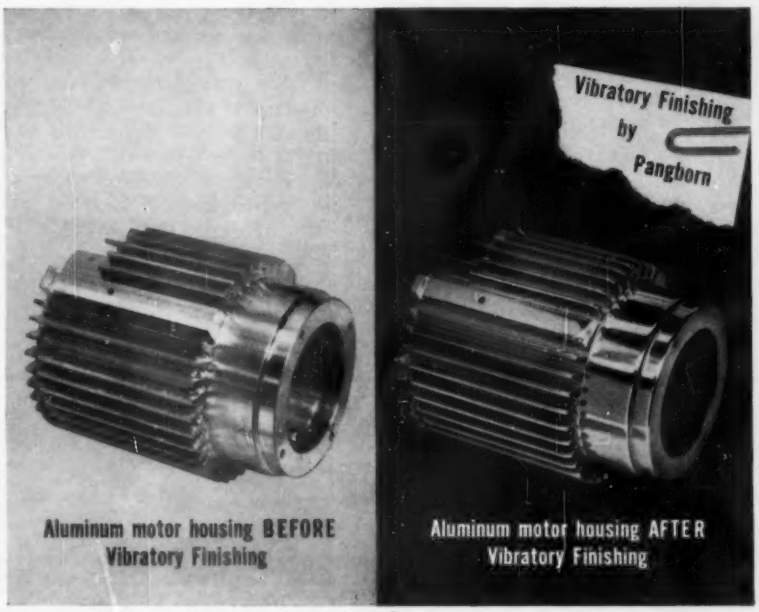
Spitfire Tool and Machine Co., 2931 N. Pulaski, Chicago, Ill. **Circle 428**

Lathe Gives High Torque at Low Speeds

This lathe combines a mechanical speed variator drive unit and a coaxial spindle design to provide an infinite selection of spindle speeds throughout a continuous range from 43 to 3500 rpm. Constant, full drive horsepower is delivered through the entire range with output speed maintained within 0.002 percent. Thus, maximum torque is provided at the lowest speeds for heavy cutting, while, at high speeds, balance



is maintained and vibration minimized. In the speed range to 400 rpm, the Micro-Turn operates through a plane-



Amazing, how inexpensive complex finishing can be!

In some cases, the Pangborn Vibratory Finishing Machine has reduced finishing time by over 90%. You know what this means in time and labor savings alone. Especially since this machine tackles complex finishing assignments with the same ease and speed as simple ones.

Its uses are amazing, too. It descales, deburrs, burnishes, radiuses, fine-finishes. It handles a wide variety of materials . . . metals, plastics and ceramics. And this machine tackles complex and difficult jobs impossible or impractical to do by other methods . . . and does them quickly and economically.

The exclusive air-cushioning system built into every Pangborn Vibratory Finishing Machine provides better and closer amplitude control and offers automatic adjustment for any weight load. Air-cushioned floor mounts eliminate any transmitted vibration. No special foundations are necessary. Variable speed controls available on all models. Automated and auxiliary equipment, media, compounds for every need. Send parts with exact finish specifications or finished specimen for sample processing in our laboratory to Mr. William Brandt at:

PANGBORN CORPORATION, 4700 Pangborn Blvd., Hagerstown, Md., Pangborn Canada, Ltd., 47 Shaft Rd., Toronto (Rexdale), Canada—*Manufacturers of Vibratory Finishing, Blast Cleaning, Dust and Fume Control Equipment; Rotoblast® Steel Shot and Grit®.*

Pangborn
OF HAGERSTOWN

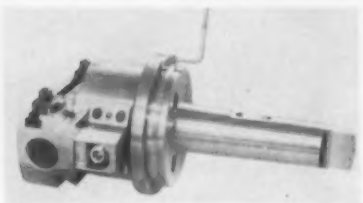
Use Reader Service Card, CIRCLE 98

tary gear unit. In the high-speed range, headstock coaxial sections lock into a single unit and the lathe operates without gearing through matched multiple V-belts directly from the main drive to the spindle. Sixty thread and 60 feed changes are provided.

Nebel Machine Tool Corp., 3418 Central, Cincinnati, Ohio. **Circle 429**

Boring Head Has Uninterrupted Feed

One feature of the CF-6E boring head is its 4-inch continuous radial tool feed. Its boring range is from 7/16 to 18 inches diameter. The head has adjustable depth of feed stops, a safety clutch which releases under overload,



micrometer adjustment for radial tool positioning in 0.0001-inch increments, and toolslide clamping for heavy boring and turning operations. The head is intended for small-diameter boring, facing, turning, backfacing, grooving and chamfering operations.

Davis Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. **Circle 430**

Actuator Provides Rotary Motion

Among the applications for the Rota-Cyl are the operation or actuation of drill presses, machine tools, valves, fixers, pressure regulators, torque amplifiers, conveyors and torque wrenches. Hydraulically powered, it performs a complete cycle within its own length, with no shafts or piston rods to extend. It can provide as many turns as desired with constant torque throughout. Because power is derived from the motion of a self-centering piston rigidly coupled to a continuous chain, the actuator is without backlash and is sensitive to minute changes in flow of the actuating fluid.

Graham Engineering Co., 714 Loma Verde, Palo Alto, Calif. **Circle 431**

Indexing Chassis for Large, Heavy Work

Designed to accommodate extra-large, extra-heavy work without sacrificing cycle time, this 30-ft-long straight

line indexing machine chassis has 70 vertical cast aluminum work carriers. Each work carrier is 11½ inches wide x 18 inches high with a travel of 12 inches. The Auto-Tran is ready for tool mounting and hydraulic tool actuation. Its chassis has a drive motor, hydraulic pump and piping and electrical wiring. An electric clutch brake for cycle control, allowing infinite adjustment of the dwell portion of the cycle, is included.

Swanson Erie Corp., 815 E. Eighth St., Erie, Pa. **Circle 432**

ANOTHER NORTON PRODUCT

Now—abrasive belt machining grinds sheets, strip, and

Instrument Indicates Unbalance, Vibration

Unbalance in parts such as grinding spindles; in assemblies such as car and jet engines; and in propeller assemblies can be diagnosed by this pulse synchronized unbalance indicator. The instrument also indicates the speed of the vibration. Filter is done by synchronous rectification circuits that reject noise through an operating range of 500 to 5000 rpm. The synchronizing pulses are obtained from the rotating part itself by means of a magnetic, photocell or capacitive pickup. A 10-millivolt peak-to-peak input signal from the vibration pickup produces a full-scale deflection.

General Motors Research Laboratories, 12 Mile and Mound Rds., Warren, Mich. **Circle 433**

Power Packs Permit Selective Plating

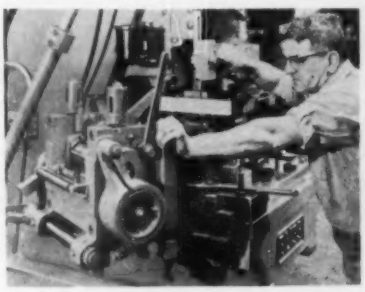
Two power packs designed for tabletop use permit controlled electroplating on specific, defined areas. A variety of metals and alloys can be deposited on almost any conducting material. Components can be plated on the spot, avoiding time-consuming disassembly and reassembly. No tanks are needed. Semiportable Model 2530 is used for research and development, prototype work and light production. Alternating current line voltage is converted to 0-25 amp, 0-30 volt d-c output. Model 6035 is intended for heavy production work. Input voltage is 220-volt, 60-cycle, single-phase; d-c output is 0-60 amp at 0-35 volts. Both models have a voltage control and a totalizing ampere-hour meter with 0.002 amp-hr divisions for controlling deposit thickness.

Selectrons, Ltd., 153 E. 26th St., New York 10, N. Y. **Circle 434**

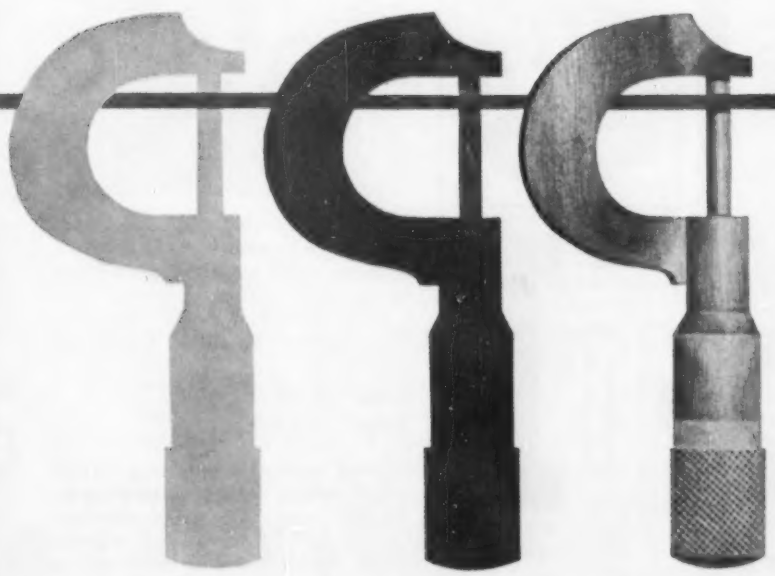
USE READER SERVICE CARD ON PAGE 167 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Portable Feed for Single, Continuous Work

This portable feed makes a press adaptable to either single or continuous operation. It can be used as a conventional single roll feed for continuous feeding or, by simply removing two bolts, can be swung away from its normal position to permit single-trip hand feeding. Further versatility is afforded by the adaptability of one feed



stainless steel coil to precision tolerances



BEHR-MANNING ABRASIVE BELTS, used on a wide variety of new machines, are providing industry with high-speed precision grinding that reduces production costs, makes better materials available for fabrication, and solves fabrication problems themselves.

Can abrasive machining cut your costs, make your products more widely applicable? Very probably. And we'll be happy to help you find out. It's a fact that Behr-Manning devotes more men, facilities and resources to coated abrasive research and development than anyone else in the world. And brings you the coated abrasives you need where and when you need them.

BEHR-MANNING CO., Troy, N. Y., a division of Norton Company.

BEHR-MANNING
Abrasive Engineering

Use Reader Service Card, CIRCLE 99

to a number of presses of the same or different tonnages. Each press must be equipped with special mounting pads, pivot bracket and throwblock to permit transfer of the feed from press to press. The feed can handle stock from 0.125 to 8 inches. It has a feed length of zero to 8 inches and a feed height of 2 to 4½ inches.

E. W. Bliss Co., Press Div., 1004 E. State St., Hastings, Mich. **Circle 435**

Optical Device Checks, Calibrates Angles

This instrument—a combination of a plane mirror and a miniature Ultra-dex indexing table—checks and calibrates angles. Called the Optic-Mechanical Polygon, it is accurate to ¼ sec of arc. total accumulated error. The base is made of two plates, each with 360 serrations, that are separated when the operating handle is depressed. The top plate can then be moved through any angle and lowered onto the bottom

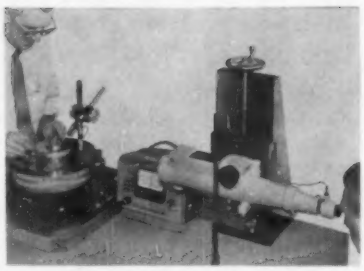
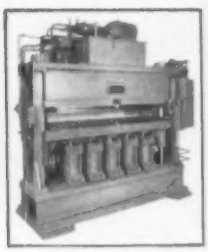
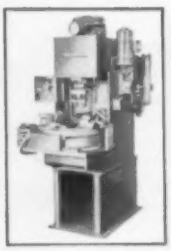
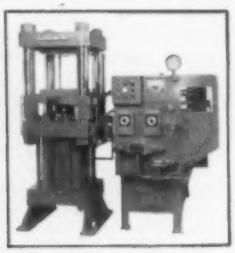
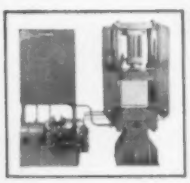
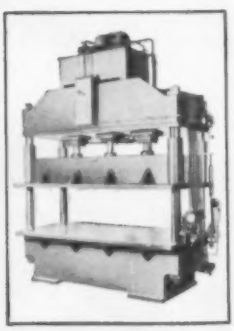


plate. Regardless of what degree of angle is being checked, all 360 serrations engage. In a typical setup, an autocollimator is directed to sight on a reference mirror and on the mirror of the polygon, which is clamped on the dividing head to be checked. The dividing head is rotated a specific number of degrees in one direction and the polygon mirror is rotated the same number of degrees in the opposite direction. The amount by which the polygon mirror does not return to its zero position is determined by sighting through the autocollimator and is a measure of the inaccuracy of the dividing head.

AA Gage Co., 350 Fair St., Detroit 20, Mich. **Circle 436**

ONE-OF-A-KIND HYDRAULIC PRESSES

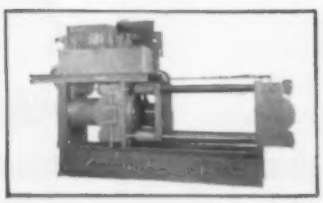
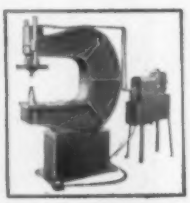
BY

HANNIFIN

Why does Hannifin, with the widest selection of standard hydraulic presses (from 1-Ton to 250 Tons) in the industry, make so many "specials"? Just one reason: Every press on this page saved money for a Hannifin customer . . . by making some product better or faster or cheaper. We may be able to save money for you. The way to find out is to call in a Parker-Hannifin man and show him how you are making your product now. He'll take it from there.

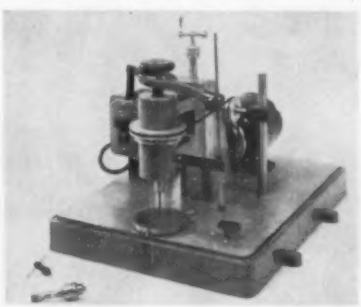
HANNIFIN PRESS COMPANY
519 South Wolf Road • Des Plaines, Illinois
A DIVISION OF PARKER-HANNIFIN CORPORATION

8500-TH

Drill Press for Small Parts

This Micro Drill Press—for drilling small, fine holes—has a throat depth of 4½ inches. The spindle which slides in sleeves has a travel of 1¼ inches. The column has a micrometer screw



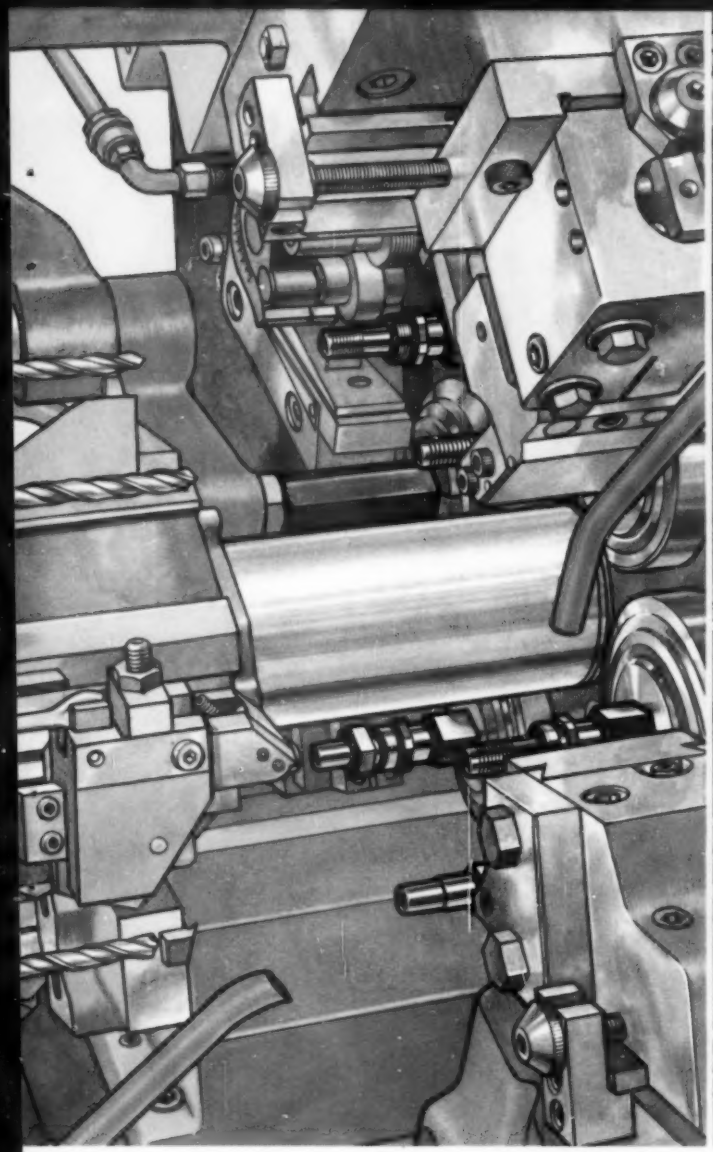
and can be adjusted two inches in 0.0001 inch graduations. Powered by a ½-hp motor, the press takes collets in sizes from 0.004 to 0.315 inch.

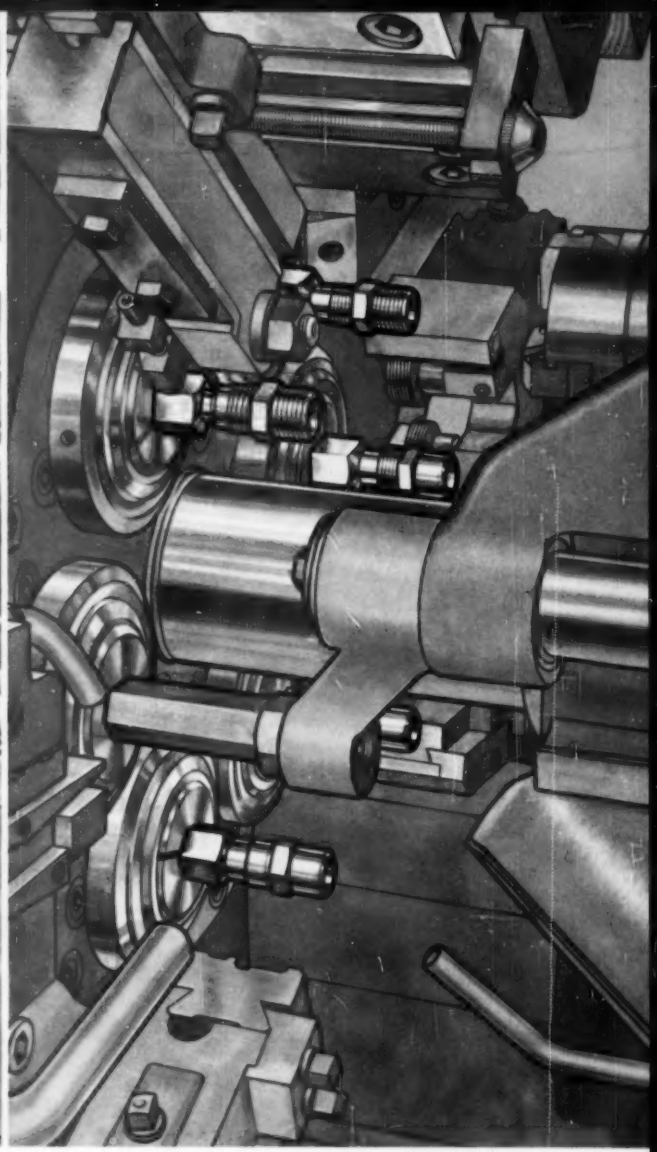
F. W. Derbyshire, Inc., 265 Bear Hill Rd., Waltham 54, Mass. **Circle 437**

Unit Cuts Plate Edge Profiles

Using three machine cutting torches with acetylene, natural gas or propane, the PE-1 plate edge preparation unit can cut straight edges as well as single bevels, double bevels or bevels with a

(continued on page 151)





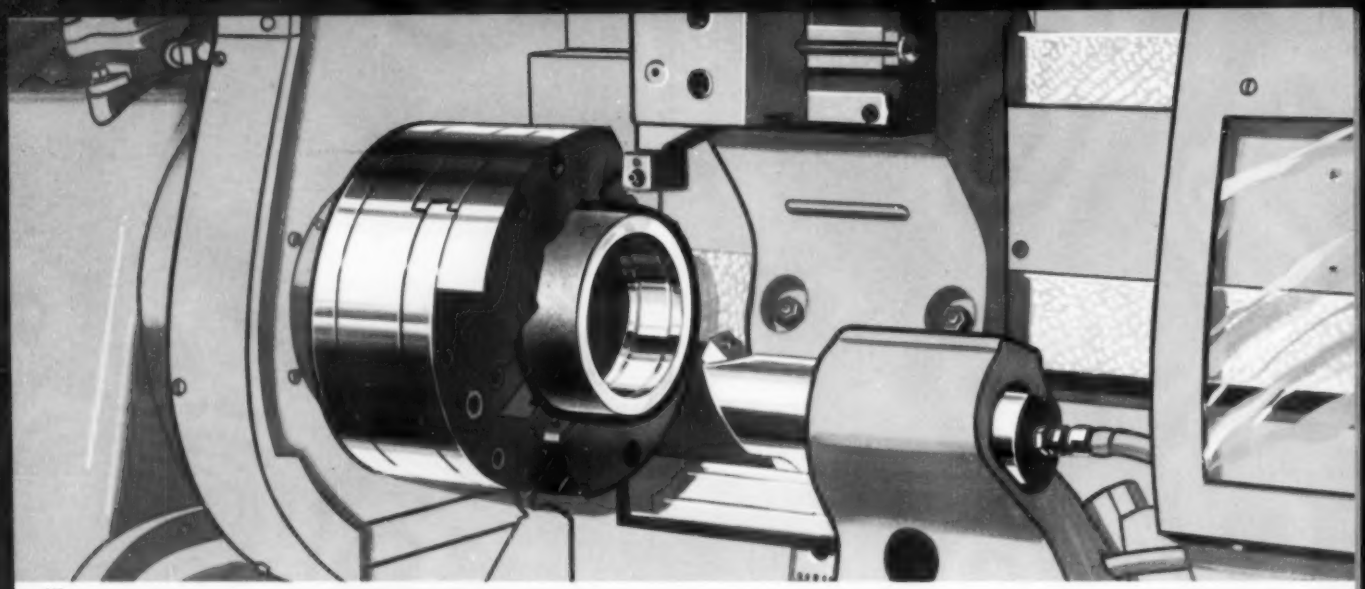
Stainless, 225 per hour— brass, 1500 per hour

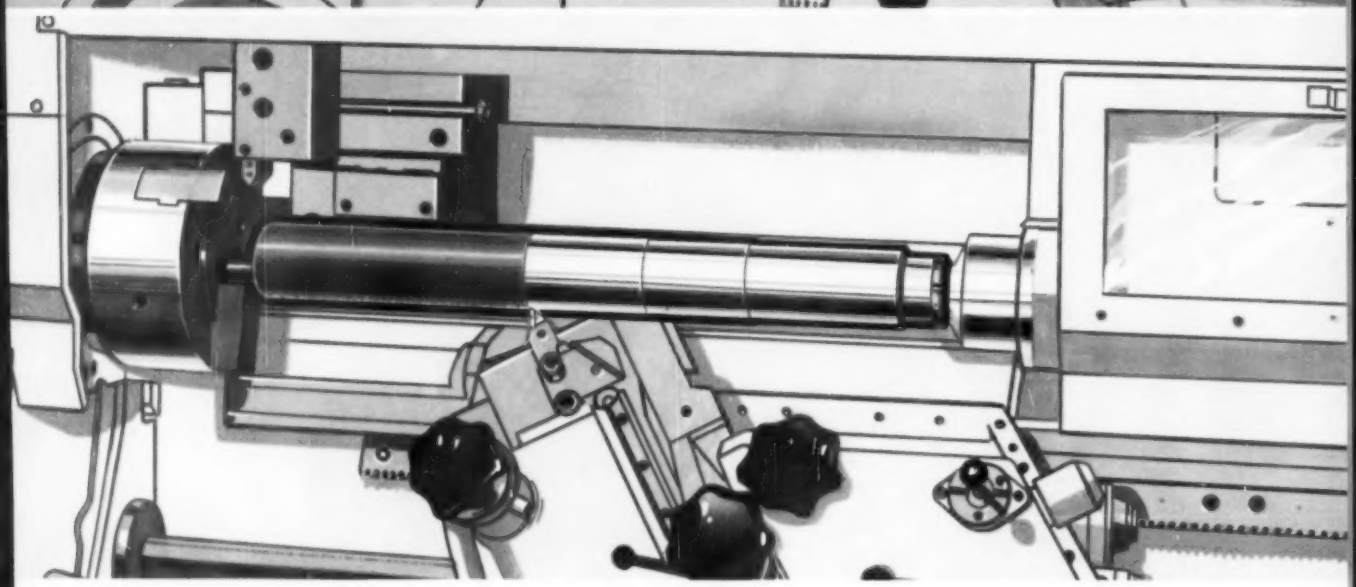
Speed is only part of the story on New Britain's completely new line of four-, six-, and eight-spindle bar machines. Guaranteed accuracy, production run after production run, year in, year out, helps round out the story. If you haven't seen any of the new series in action—six models in all—you owe it to yourself and the profitable productivity of your plant to arrange for a demonstration. All of the exclusive New Britain features you are probably familiar with have been retained and improved. New features unavailable on any other machines have been added. The result—the finest high speed bar turning units on the market. Your New Britain representative is the man to see. He can show you applications, parts production case histories, show you to fractions of seconds and pennies why new New Britain bar machines are an investment in greater profits with every piece they produce.

Model	Spindles	Cross Slides	Spindle Speeds	Spindle Capacity	H.P.
450	4	4	41-621	5⅛"	30-50
52	6	6	271-4250	1¼"	15-25
62	6	6	177-2519	1⅝"	15-30
62	6	6	177-2519	2¼"	20-30
635	6	6	63-630	3½"	30-50
826	8	6	98-1481	2⅝"	30-50

THE NEW BRITAIN MACHINE COMPANY

New Britain-Gridley Machine Division • New Britain, Connecticut





Years-ahead flexibility
in New Britain's +GF+ *Copying Lathes*

One of the best ways of making sure you're on the right track when you buy a new machine is knowing what you want the equipment to do and then being sure the equipment you buy can do it. This sounds pretty basic, but it's difficult to forecast just what you are going to require of a machine through all the years you will use it. In this department, the New Britain +GF+ Copying Lathe has a lot of peace-of-mind insurance built right into it. For instance, the basic design of the machine suits it for a wide variety of work. The single-tool copy-turning principle is equally well suited for both chucked *and* between-centers work on internal and external surfaces.

Because the tool path is controlled by an easy-to-install template (or a prototype) set-up and change-over are accomplished in a few minutes. The cutting tool can be replaced in a matter of seconds. Back facing is accomplished as part of the machining cycle by means of a top-mounted attachment.

The New Britain +GF+ is truly a machine that can pull more than its own weight in any metal-working shop. On top of that, it can adapt quickly and easily to the widest possible number of new requirements that may be placed on it in the years to come. A new catalog describes the complete line in detail.

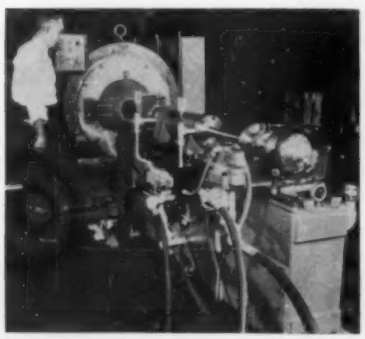
THE NEW BRITAIN MACHINE COMPANY
New Britain-Gridley Machine Division • New Britain, Connecticut

nose. It is well-suited for applications where heavy plate edges must be prepared with a variety of edge contours. The cutting nozzles float freely as a plate riding wheel moves over the work surface. This assures smooth, uniform cuts by maintaining the proper nozzle-to-workpiece distance regardless of surface contours or waves which could cause irregular cuts. When approaching the end of a cut, the free floating feature can be locked out so that the nozzles will not drop onto the work as the wheel moves off the edge of the plate.

Linde Co., 270 Park Ave., New York 17, N. Y. **Circle 438**

Swaging Machine Handles Many Jobs

Size capacity has been doubled over former models with the 3H Hydroformer. With it fittings up to $\frac{5}{8}$ inches in diameter can be swaged for attachment to cable or flexible hose. A modified type of rotary swaging machine, the unit permits the insertion and withdrawal of workpieces so that they can be swaged between shoulders. It can also be used as a conventional rotary swager and, as such, will form nonferrous light wall tubing up to $4\frac{1}{2}$ inches in diameter and low tensile strength solid stock up to $2\frac{1}{4}$ inches in diameter. The machine consists of a head ring, a set of 12 caged rollers, 12 pairs of opposing dies and operating wedges.



Fenn Mfg. Co., Newington, Conn. **Circle 439**

USE READER SERVICE CARD ON PAGE 167 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Cutters Have Built-In Adjustment Scales

Shown here are four boring bars with scales calibrated in increments of 0.0001 inch within a range up to $\frac{1}{4}$ inch. The first has two independent adjustments. One is coarse to adjust diameter in increments of 0.001 inch and the second is for setting to 0.0001 inch. Total on the coarse adjustment is 0.250 inch on diameter and fine adjustment range is 0.044 inch. Nominal size variation is from $\frac{1}{8}$ to $\frac{1}{2}$ inch by

New ARMSTRONG "90" SERIES RATCHET

The ONLY Ratchet with ALL these important features!

1 Slenderized head
2 Thumb-operated reversing lever specially designed so it won't come off
3 Reversing-lever stop (Ball-and-spring prevents accidental shifting)
4 Simple to clean—only tool required is a Phillips screwdriver (wearable parts may be individually replaced)
5 Thin handle with knurled grip
6 Hole in handle for convenient hanging
7 Fine-toothed gear
8 Easy ratcheting action
9 ¼", ⅜", and ½" square drives (two handle lengths in ½" drive)

All wearable parts are replaceable; individually, inexpensively, easily. With no teeth cut into handle, it need never be replaced. *"ARMSTRONG" on these ratchets guarantees: advanced design, top quality and tool sense.

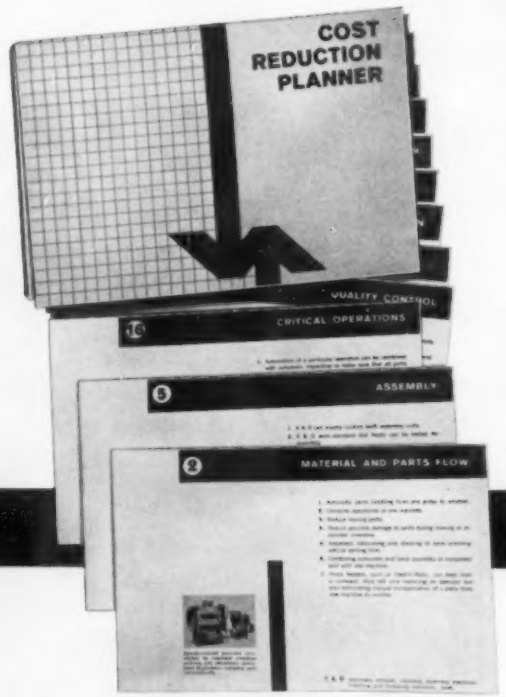
Extra heavy duty "50" Series ARMSTRONG ratchets (see right) in 1", ¾", ½" and ⅜" square drive sizes. Our General Catalog 700, gives complete information on these and approximately 5500 other ARMSTRONG tools. Your local ARMSTRONG Distributors will supply you a Catalog and demonstrate the new ratchets. If you don't know who he is, write us for his name.

ARMSTRONG BROS. TOOL CO.

5257 W. ARMSTRONG AVE. • CHICAGO 46, ILLINOIS

Use Reader Service Card, CIRCLE 107

SOME CUES FOR THE ACTIVE COST-REDUCER



This PLANNER is for the man who doesn't have time to waste determining whether a supplier can help him produce at less cost. If you're this type of active cost-reducer, we know we're welcome. It takes only five minutes to go through this PLANNER and not much longer to get us started on any project it may suggest. Like to have our man in your area call? Please contact Emhart Manufacturing Company, Hudson Division, Hudson, N. Y.

EMHART

COST REDUCTION IN SMALL PARTS PRODUCTION

This is our business — and to prove it, we'd like to go over at least sixteen areas in which we've had good, hard practical experience. Here they are:

1. PRODUCT DESIGN
2. MATERIAL AND PARTS FLOW
3. PACKAGING
4. FABRICATION
5. ASSEMBLY
6. DIRECT LABOR
7. INDIRECT LABOR
8. METHODS SIMPLIFICATION (People)
9. METHODS SIMPLIFICATION (Machines)
10. QUALITY CONTROL
11. IN-PROCESS INVENTORY
12. MAINTENANCE
13. FLOOR SPACE
14. SPARE PARTS INVENTORY (Customer)
15. SPARE PARTS INVENTORY (V & O Machines)
16. CRITICAL OPERATIONS

V & O AUTOMATIC PRESSES AND FEEDS

Use Reader Service Card, CIRCLE 109

TOOLS of today

the use of interchangeable heads.

The second bar has a total adjustment range of 0.004 inch in 0.0001-inch increments. The third, for boring any size hole in any kind of machine whether the bar is on centerline of the

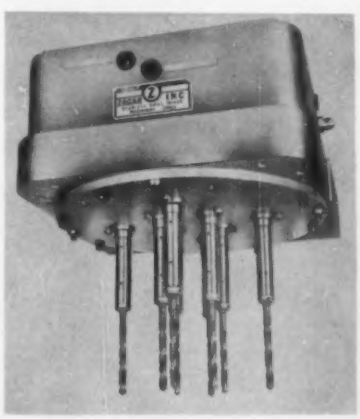
part or not, is adjustable in increments of 0.0001 inch over a range of 0.008 inch. The fourth has both coarse and fine adjustment and uses throwaway inserts. Size variation, by use of interchangeable heads, is ½ to 3 inches.

Wesson Corp., 1220 Woodward Heights Blvd., Ferndale 20, Mich. **Circle 440**

USE READER SERVICE CARD ON PAGE 167 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Slip Spindle Adds to Drill Head Versatility

Slip or cartridge type spindles are now available on a line of multiple spindle gearless heads used for drilling, reaming and tapping. The slip-spindle drill is driven by a gearless spindle



drive. The plate into which the spindles are inserted is prebored to accept spindles in various patterns. With this arrangement, spindles are easily inserted and removed but the rigidity and accuracy of fixed-center drilling is re-

Solenoid Contact 70/min.
Wire Clamp 90/min.
Still more parts from wire!
Gear Blank 60/min.
Shuttle Tip 70/min.
Shock Absorber Bolt 85/min.
Lock Nut Blank 80/min.
Pipe Plug 100/min.
These important parts are cold-formed from wire, start to finish in compact, efficient National Cold Headers.
Practically scrapless, all these parts achieve remarkable savings over past methods.
If you make odd-shaped parts, may we help you evaluate them for cold-forming from wire? Better yet, come to Tiffin, witness our demonstrations and let's discuss your work.
National ½" Five-Station Progressive Cold Header
NATIONAL MACHINERY CO.
TIFFIN, OHIO, U.S.A.
HARTFORD DETROIT CHICAGO

Use Reader Service Card, CIRCLE 110

tained.

Since there are no gears and joints, over-all height of the head is small. A minimum spindle extension is required, making an over-all height of 7¾ inches possible in the smallest head size.

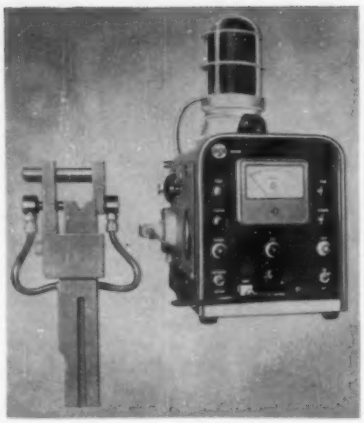
Four standard head sizes cover maximum bolt circle areas of 6½, 10½, 12½ and 15½ inches. Spindle sizes are 1¼ and 1½ inches. The heads can be mounted on round or flange type quill machines.

Zagar, Inc., 23892 Lakeland Blvd., Cleveland 23, Ohio. **Circle 441**

USE READER SERVICE CARD ON PAGE 167 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Gage Controls Centerless Grinders

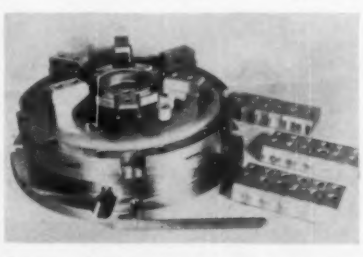
This gage consists of a limit signaling comparator, which operates on air-electronic principles, and a gaging station fixture with twin air jets on a V-block which is mounted to the end of the centerless grinder rest blade. Parts leaving the grinder enter the fixture and pass between the opposing air jets. The increase or reduction of the airflow caused by part-diameter variations is translated into a signal that actuates a meter and signal lights. The warning light on top of the unit and the upper and lower limit lights on the front panel of the comparator warn the operator that parts out of preset tolerances are being produced. A green light on front of the unit flashes as acceptable parts are gaged.



Radio Corporation of America, Industrial and Automation Div., 12605 Arnold, Detroit, Mich. **Circle 442**

Air-Operated Chuck Has High Repetitive Accuracy

When using this diaphragm chuck, the workpiece is chucked and released by compressed air. The air exerts pressure on a piston which flexes the steel diaphragm, opening the jaws the necessary thousandths of an inch. When pressure is removed, the diaphragm flattens, closing the jaws and gripping the work. The unit—for use in either internal or external chucking—is made of 5½-inch-diam, three-jaw models; 7-inch-diam, four-jaw models; and 10-inch-diam, six-jaw models. It provides high-speed chucking with repetitive accuracy of 0.00015 inch.



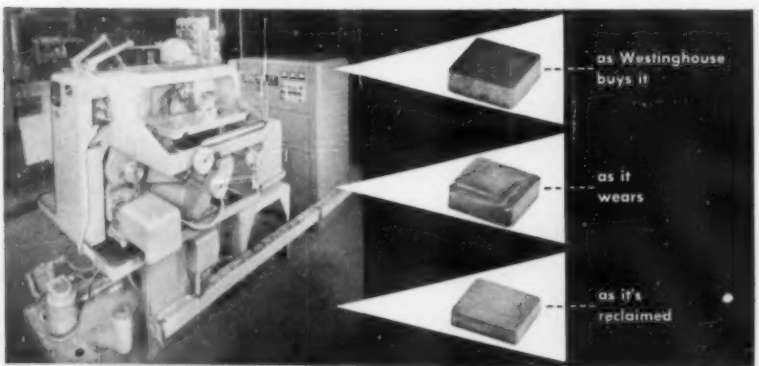
Erickson Tool Co., 34350 Solon Rd., Solon, Ohio. **Circle 443**

STOP... Throwing away those THROW-AWAYS

Westinghouse RECLAIMS THROW-AWAY INSERTS

FOR 25¢ EACH... GRINDS CARBIDE TOOLS FOR PENNIES WITH THEIR

Hammond ELECTROLYTIC GRINDER



Here is one of the Hammond Model CBE-66 Combination Chip Breaker and Diamond Finishing Electrolytic Grinders serving Westinghouse.

Yes, in plant after plant across the nation, cost analysis verifies the dollars and cents value of Hammond Electrolytic Grinders. See for yourself! Send us today a few single-point tools to be ground. They'll be returned promptly with a "processing and time required report". No obligation.

Gentlemen:

Since we installed a Hammond Electrolytic Grinder, we *now* grind carbide tools for *pennies*. Here we have electroplating in reverse — a sort of "deplating" that removes metal instead of depositing it.

The electrolytic action crumbles the surface of the carbide and the diamond wheel brushes away the "crumbs" and polishes the surface. Since the electrolytic action has done about 90% of the work, the diamond wheel will last eight times as long.

We also reclaim worn carbide throw-away inserts for *25 cents — saving $1.94* on each reclaimed insert.

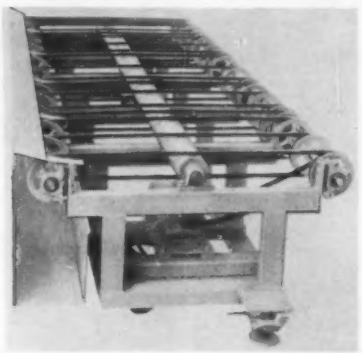
J. T. RICE, Supervisor, Manufacturing Engineering
Westinghouse Large Rotating Apparatus Dept.

Hammond Machinery Builders Inc.
1661 DOUGLAS AVE. KALAMAZOO, MICH.

Use Reader Service Card, CIRCLE 111

Electrical Machine Stacks Sheared Sheets

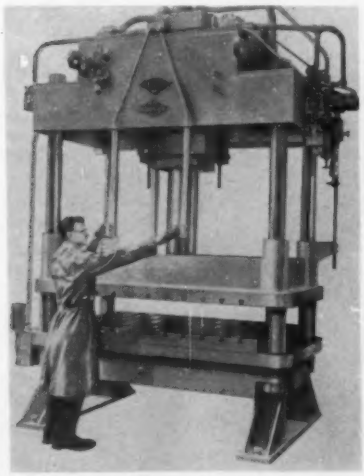
Space-saving, maintenance-free stacking of sheared blanks is provided by the AAC Shearstack. It has an automatic scrap deflector which operates like a drawbridge. When a piece of scrap is to be handled after shearing, the operator pushes a button and the scrap deflector opens electrically and the scrap falls through into a scrap bin. At the next stroke of the shear, the deflector closes automatically, allowing the following blank to pass over it onto the machine for stacking. The machine is constructed with adjustable shafts to accommodate varying belt tensions. Its over-all depth is less than 4 ft. It is available for 4, 6, 8, 10 and 12-ft shears and can handle up to ⅛-inch steel or ⅜-inch aluminum.



American Actuator Corp., Box 384, Stamford, Conn. **Circle 444**

Trim Press Produces Clean Castings

This four-bar hydraulic trim press has an adjustable deceleration valve and is capable of exerting 100 tons of trimming stroke pressure. Approach speed is 900 ipm; return speed 875 ipm.



STANDARD'S
Center-Cutting
END MILLS . . .

Built TOUGH ENOUGH for tough metals . . .

. . . whether it's plunge or traverse cutting . . . profiling . . . cavity milling . . . die sinking or conventional slot milling, STANDARD'S END MILLS perform longer, more efficiently, with a finer work finish on difficult machining operations.

• . . . Call the STANDARD Distributor in your area, he will show you a variety of TWO-, FOUR- and SIX-FLUTE, Double or Single End Mills . . .

MORE metal removed at LESS COST • Standardize • with STANDARD • Quality!

DEPEND upon STANDARD'S Authorized Distributors . . .
For Twist Drills, Reamers, Taps, Counterbores, End Mills, Milling Cutters, Hobs, Gages, Dies, Carbides (solid or tipped) . . . and for Engineering or Technical Information.

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3950 CHESTER AVENUE CLEVELAND 14, OHIO
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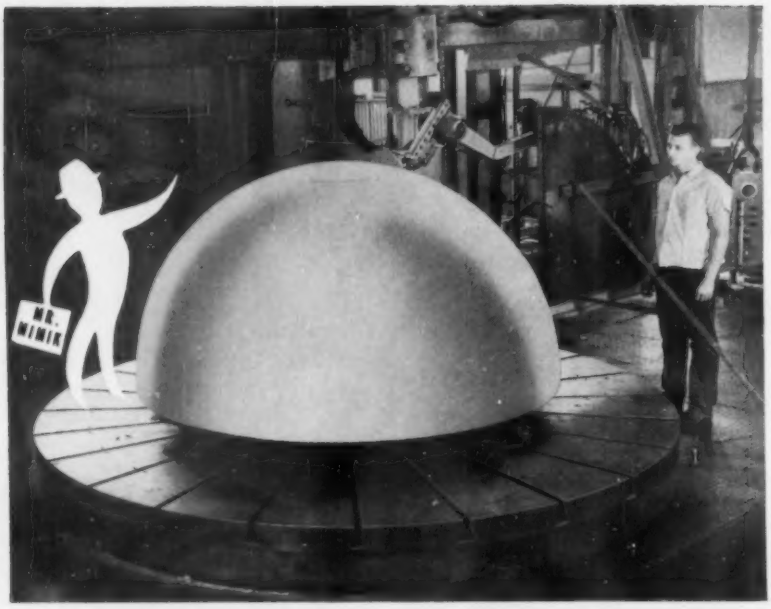
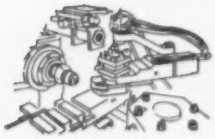
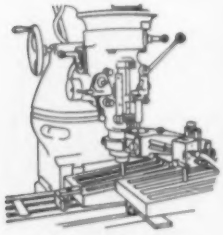


SPACE AGE TRACING WITH MIMIK®



Turret Lathe



Milling Machine

Engine Lathe

Large spherical and contoured surfaces offer no problem to the versatile Mimik Hydraulic Tracer at Kinco Inc., Montebello, California. With a Mimik high precision tracer installed on this 144-inch boring mill, contoured surfaces can be held to exacting tolerances and finishes. This Mimik Tracer can also be transferred quickly to any other mill in the Kinco plant when needed.

Contour machining of large or small components in short or long runs is ideally handled by Mimik where tracing gives big savings in set-up time, tooling and finishing. The versatile and highly interchangeable Mimik will upgrade your existing machines, improve your competitive position and give you a high degree of flexibility to meet today's rapidly changing production demands.

Enquire of Mimik's unique guarantee of time and performance related to a specific job and machine. Write today for more information on Mimik applications for engine and turret lathes, V.T.L.'s and milling machines, or ask for your local Mimik-man to call.

Ask about the new Mimik Templator, too. Working direct from drawings, tracing templates can be cut accurately and simply, in minutes, to .0002". No layout, sawing, filing or polishing required.

MIMIK® TRACERS

MIMIK TRACERS INC., Buffalo, N.Y.
EAST: Mimik Tracers Inc., 3901 Union Rd., Buffalo, N.Y.
CENTRAL: Bartsch Tool Corp., 3714 Oakton St., Skokie, Ill.
WEST COAST: Allied Pacific Manufacturing Co., Compton, Cal.
CANADA: Retor Developments Ltd., Galt, Ontario

Mimik-men are everywhere

Use Reader Service Card, CIRCLE 113

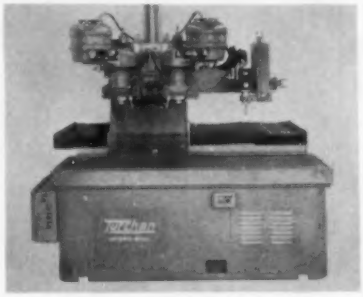
TOOLS of today

The slow trimming action at 59 ipm produces neatly sheared castings. Other features of the machine include a 36 x 72-inch die area, a supporting 52 x 88-inch base platen, safety stops on the tie bars and a 30-inch stroke.

B & T Machinery Co., Holland, Mich. **Circle 445**

Tracer Mill Machines Large Parts

This two-spindle automatic tracer mill, capable of three dimensional tracing on both spindles, has a stationary 20¾ x 78¼-inch worktable to accommodate parts and models up to

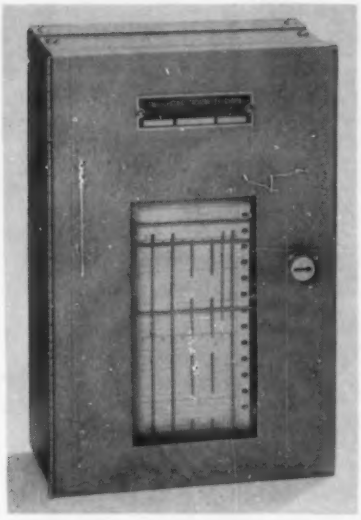


13 x 36 x 12 inches. Center distance between the spindles is 18 inches. The Hydro-Mill has a tracer control for a combination of profiling and contouring. This controls hydraulic actuators on the vertical slide, saddle and ram. Feed rates on all three dimensions are zero to 40 ipm. Motors up to 5-hp are available for each spindle, with spindle speeds of 150 to 11,750 rpm possible. Other features include auxiliary spindle controls, separate leadscrew adjustment on each spindle, a self-contained power unit in the machine bed and automatic spindle brakes.

Turchan Follower Machine Co., Box 157, Inkster, Mich. **Circle 446**

Recorder Charts Machine Time

Operating time and downtime of as many as ten machines or processes can be recorded simultaneously, automatically and continuously with the Model OR-4 operation recorder. This electrically operated strip chart unit avoids maintenance problems by using waxed charts. Behind the chart is a stationary heating element for each channel that melts a small portion of wax, allowing the blue chart paper to show whenever the machine is operating. The chart is driven by a timing motor to form this melted portion into a continuous vertical line. The instrument can be in-



stalled at the machine or at any remote location.

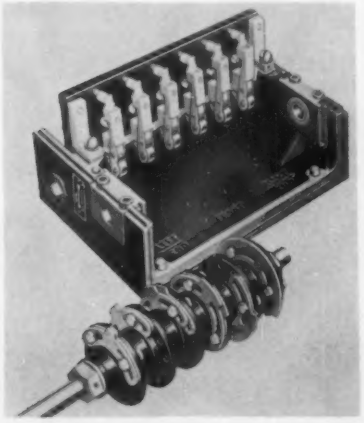
Electric Tachometer Corp., 68th and Upland Sts., Philadelphia 42, Pa. **Circle 447**

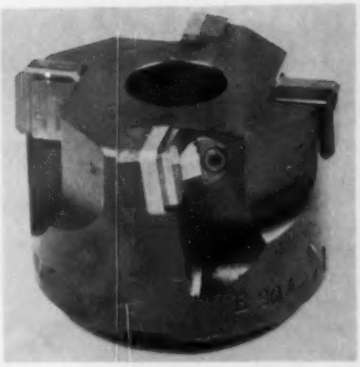
USE READER SERVICE CARD ON PAGE 167 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Rotating Cam Limit Switch

Shown here is the Bulletin 102 Type CL rotating cam limit switch with its shaft and cams removed. The shaft of this control device can be connected to a rotating element by direct coupling or driven by a gear train or roller chain. The unit can have from 1 to 12 cams for operating separate switches. Each switch, in turn, can limit the travel of a machine member or initiate operating function for any length or angular travel from 18 to 360 deg. Maximum speed at which the shaft can be rotated is 75 rpm. The switch has sealed, lubricated ball bearings which will withstand a thrust load of 100 lb, and double-break silver-to-silver contacts.

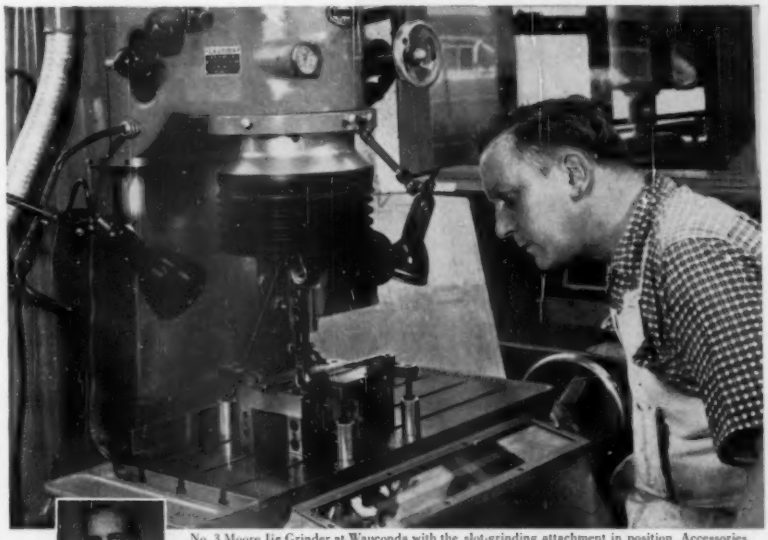
Clark Controller Co., 1146 E. 152nd St., Cleveland 10, Ohio. **Circle 448**





End Mills for Light Duty Milling Machines

Indexable throwaway carbide inserts are used in the Index-O-Cut end mill. The mill has a one-piece steel body with replaceable anvils, carbide chip deflectors and K-shaped locking wedges. It is available in styles with triangular



No. 3 Moore Jig Grinder at Wauconda with the slot-grinding attachment in position. Accessories like these bring out the full versatility of Moore equipment and help solve "impossible" jobs.

"Moore equipment enables us to produce millions of parts to exacting tolerances"

says Kenneth Pearson, Co-owner, Wauconda Tool & Engineering Co., Inc. Algonquin, Illinois.

"Specializing in out-of-the-ordinary, close-tolerance press and multi-slide work, it is essential for our plant to have the best toolroom equipment.

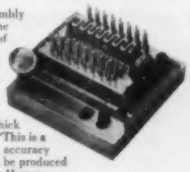
"Our Moore Jig Borers and Jig Grinders make it possible for us to do the unusual in the line of accuracy required for our precision die work and enable us to produce millions of parts to the exacting tolerances that are so essential in computer, missile, instrument and electronic components.

"These machine tools do the ordinary as well as the extraordinary, day in day out, and are in constant use. The rigidity, durability and precision built into Moore equipment makes them unequaled for our exacting requirements.

"We base our business on the premise that quality is remembered long after the price is forgotten. Moore equipment contributes in large measure to this quality."

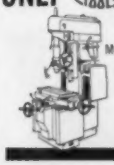
Write today for literature describing the unique features of No. 3 Moore Jig Borers and Jig Grinders.

Moore Special Tool Company, Inc., 732 Union Avenue, Bridgeport 7, Conn.



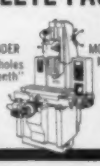
Contour grinding on a punch assembly for an intricate progressive die. The entire shaped contour, consisting of individual inserts, has been jig ground, with outside and inside radii ground in the assembled state and the straight portions ground as individual inserts. Note coin for comparative size. The stamping produced is .006" thick and must be absolutely burr free. "This is a good illustration of the versatility, accuracy and high degree of finish that can be produced on Moore equipment," says Henry Harper, Co-owner of Wauconda Tool & Engineering Co., Inc.

ONLY MOORE TOOLS CAN OFFER THIS COMPLETE PACKAGE OF PRECISION



MOORE No. 3 JIG BORER
Locates and bores holes to less than a "tenth"

MOORE No. 3 JIG GRINDER
Locates and grinds holes to less than a "tenth"



MOORE UNIVERSAL MEASURING MACHINE
Measures to one-third of a "tenth"

MOORE ROTARY TABLE
Divides the circle to less than 2 sec.

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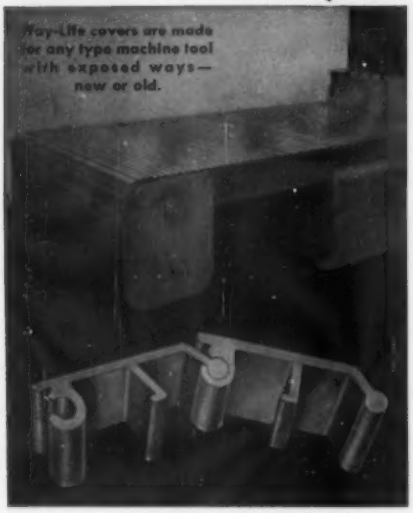
Protection for Man and Machine

FUTURMILL'S "Way-Life" WAY COVERS



Way-Life covers are lightweight—yet very strong. The extruded aluminum sections are ribbed full length with a full length ball and socket type interlocking hinge.

SAVE THE WAYS—"Way-Life" covers keep chips, grit, dirt and other foreign matter out of the ways and feed mechanisms. The solid aluminum, interlocking sections will absorb a considerable amount of shock and prevent damage to the ways—such as caused by accidental dropping of heavy objects on the ways.

WORK WITH SAFETY—The strength and rigidity of "Way-Life" covers permit operators to walk safely on top of the cover, making machine servicing and job set-up safer and easier. It is impossible for personnel to fall through the cover or become caught or trapped between the ways.

CUT COST & MAINTENANCE—Unlike fabric, rubber, plastic, sheet metal, foil, telescopic, or accordion type covers, "Way-Life" covers will not burn, warp, tear, rust or buckle. They require no auxiliary power since the cover is motivated by table or column movement. No special servicing is necessary.

DRESS UP YOUR SHOP—"Way-Life" covers are *full dress—armored protection* for any machine . . . a complement of utility—economy and cleanliness for any shop.

Write: **FUTURMILL, Inc.** 19720 W. Eight Mile Road Southfield, Michigan

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McCROSKY

Jack-Lock

MILLING CUTTERS

Face Mills; Shank and Shell End Mills; Half Side and Staggered Tooth

● Featuring our nationally acclaimed, shop-proved Jack-Lock construction, these cutters combine the rigidity of solid tools and the economy of inserted blade design. Standard sizes from 3" to 24" dia. Engineered to meet the power potential of modern machines. For lowest cutting costs and utmost performance, specify "McCrosky"!

Send for Bulletin No. 18-M Today. It gives full details.

McCROSKY TOOL CORPORATION
MEADVILLE, PA.

COST CUTTING TOOLS

Engineering and Sales Representatives in the Principal Cities

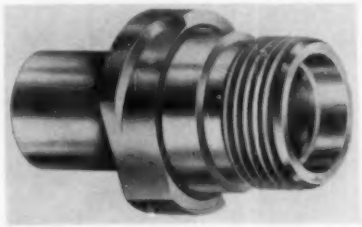
Use Reader Service Card, CIRCLE 116

or square inserts, positive or negative rake, and with no-lead or lead approach angles. Sizes for shank type end mills are from 1½ to 2½ inches and for shell end mill types from 2½ to 4 inches.

Greenleaf Corp., Newcomer Tool Div., 512 Franklin Ave., Pittsburgh 21, Pa. **Circle 449**

Bushing Tips Provide Portable, Fixed Mounting

Drilling, tapping and other self-contained machining units can be temporarily or permanently mounted on a jig or fixture with Taper-Lok drill bushing tips and accessories. The threaded end of the tip screws into the nosepiece of the drilling unit. The flanges fit under the shoulders of lockscrews or lock strips on the jig, holding the drilling unit in alignment and absorbing both the thrust and torque of drilling. A 30-deg turn locks or unlocks the unit.

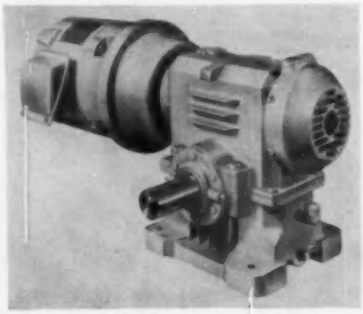


Jam-up as the chips work back into the nosepiece and out the slots in the sides is eliminated. The tips and parts will fit air tools, back spot facers, drills and tappers.

American Drill Bushing Co., 5107 Pacific Blvd., Los Angeles 58, Calif. **Circle 450**

Gearmotor Attains High-Ratio Reduction

Apparatus driven by belts, chains or spur gearing can be controlled by the Type W right-angle gearmotor. It is available with a-c motors in NEMA frame sizes from 182 to 286U or with

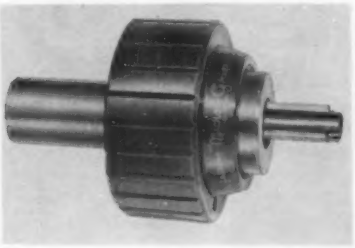


d-c motors in sizes 187A to 286A. Single reduction worm gearing provides high-ratio reduction with few moving parts. The right-angle drive arrangement requires a minimum of space. The involute helicoid thread form is used with the worm gearing, giving it high load capacity and high efficiency.

Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh, Pa. **Circle 451**

ID Chucks Have High Accuracy

Repeatability accuracy to 0.0002 inch TIR is one feature of the Micro-Grip ID chuck. It has three expanding interchangeable jaws and shoulder stop. The chuck can be attached to the machine

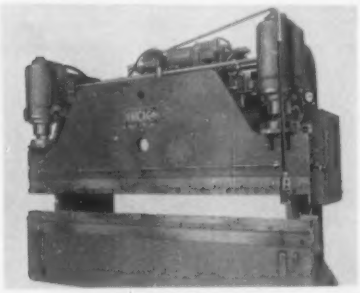


tool with a collet, chuck or faceplate or it can be used as a mandrel and held between centers. Five sizes cover inside diameters ranging from $\frac{3}{8}$ to $3\frac{1}{2}$ inches. Special models have threaded jaws, extra long jaws or multiple diameter jaws. Expansion range per set of jaws is $\frac{1}{64}$ inch for smaller sizes and $\frac{1}{32}$ and $\frac{1}{16}$ inch for larger sizes.

LeCount Tool Works, Inc., P. O. Box 252, Cheshire, Conn. **Circle 452**

Hydraulic Press Brake Has Variable Ram Speed

Features of the Chicago hydraulic press brake include a variable delivery pump with simplified valve and piping circuit; electronic sensing for ram-leveling control; infinitely variable



ram speed within specification limits; and zero positioning. The brake is offered in 42 sizes from 100-ton to 1000-ton capacity.

Dreis & Krump Mfg. Co., 7400 S. Loomis, Chicago 36, Ill. **Circle 453**

Cast Alloys for Tooling

Wessonite H—one of two cast alloys for tooling—is well-suited for general purpose machining of both ferrous and nonferrous metals. Wessonite HX is designed for use where there is a minimum of shock and impact. The first is available in the form of solid toolbits, cut-off blades, tipped tools and preformed tools and blanks. The second is available in square, rectangular and round toolbit sizes. The alloys are composed principally of cobalt, chromium, tungsten and columbium carbide. The columbium carbide lowers the frictional coefficient for easier chip flow, and increases toughness of the toolbit. Cutting speeds with the alloys range from 100 to 190 fpm for cast iron, from 50 to 300 fpm for steels and up to 1250 fpm for aluminum.

Wesson Corp., 1220 Woodward Heights Blvd., Ferndale 20, Mich. **Circle 454**

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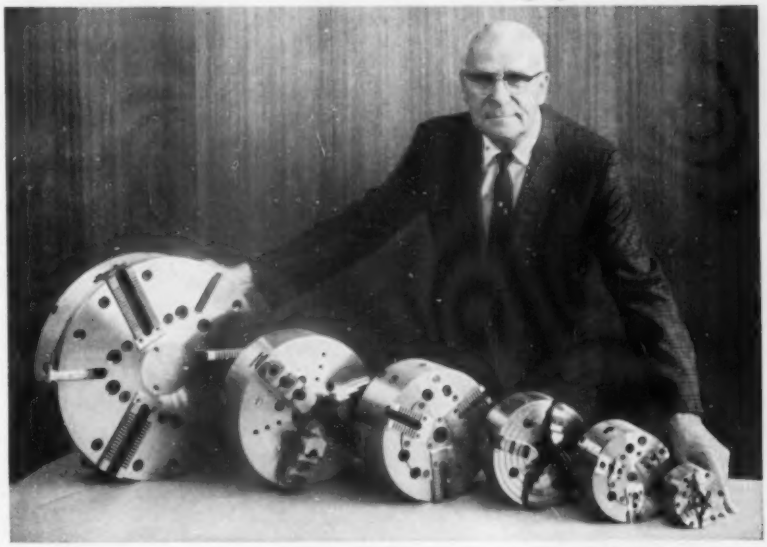
Here they are—the *Buck* chucks that solve most work-holding problems



Left to right:
6 of the 15 types of Buck chucks.

1. Aluminum power chuck with gibbed keyways
2. Dust proof chuck
3. Steel Power chuck, Serrated Jaws
4. Independent chuck
5. Steel Power chuck, American Standard
6. 6 jaw Ajust-Tru

Ready to cut your machining costs

You start saving—on production or in the tool room—the day you put Buck Ajust-Tru chucks to work.

MANUAL chucks adjust for dead true precision in a minute—*guarantee .0005" precision chucking duplicate parts.*

POWER chucks—steel or aluminum body, regular or serrated jaws—*guarantee precision within .001"* and provide many other exclusive operating savings.

It's the unique, patented Buck Ajust-Tru principle that makes Buck chucks so different—*at no price premium.* It'll be well worth it to get full details.

NEW Catalog 61 ready—write for it.

BUCK TOOL COMPANY

1133 SCHIPPERS LANE • KALAMAZOO, MICH.

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for chipless forming of internal threads

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Winter Brothers fluteless 'Rocket' Taps produce superior threads in materials such as aluminum, brass, copper, ductile steel and die castings by chipless forming, rather than by cutting. Because these taps actually displace metal without removing it, no chips are formed to clog flutes and cause tap breakage. Resharpening is virtually eliminated; longer tool life is assured. Formed threads are extremely accurate, have an excellent burnished finish and offer maximum strength.

'Rocket' Taps are stocked by your local Winter Distributor. Call him today for complete information. Or, write for our free, informative brochure on 'Rocket' tapping.

WINTER BROTHERS COMPANY

Rochester, Michigan, U.S.A.

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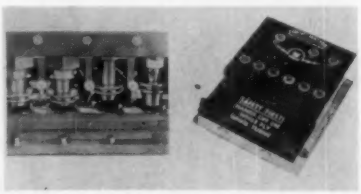
TOOLS of today

Device Pinpoints Press Malfunctions

Failure of die blank work to transfer from one station to the next is one condition which will cause this electronic device to halt the press. The unit will also indicate on a control



panel the station where the potential problem lies. Die damage, downtime and press slowdowns for any number of stations are eliminated by the Autotransfer. The unit also automatically compensates for temperature changes, voltage fluctuations and mechanical changes which may occur as the press warms up.

Wintriss Controls, 20-24 Vandam St., New York 13, N. Y. **Circle 455**

Portable Device Tests Hardness

This portable hardness tester—the Introdyne Model H-1—provides reading on Rockwell scales A, B, C and D with accuracy of plus or minus one point. The unit weighs 23 lb, requires no special installation and works while in use on a moving platform, if necessary. Its loading mechanism has a beryllium copper spring with practically zero hysteresis and drift. Thus, weights and levers are eliminated and calibration is

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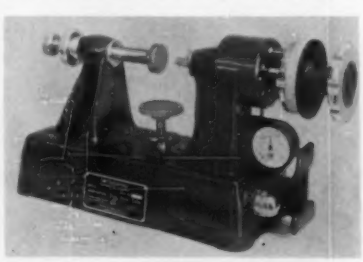
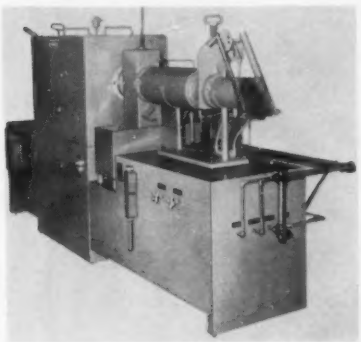


permanent. The loading mechanism and penetrators are in accordance with ASTM and ASME specifications.

Advance Industries, Inc., P. O. Box 128, South Acton, Mass. **Circle 456**

Furnace Allows Air or Oil Quenching

Primary feature of this tube type heat-treating furnace is the choice of quenches it offers. A chute between the heat chamber and the cooling jacket permits either oil quenching or atmosphere cooling. Automatic flame curtains at the entry or charging door, as well as at the discharge door, prevent



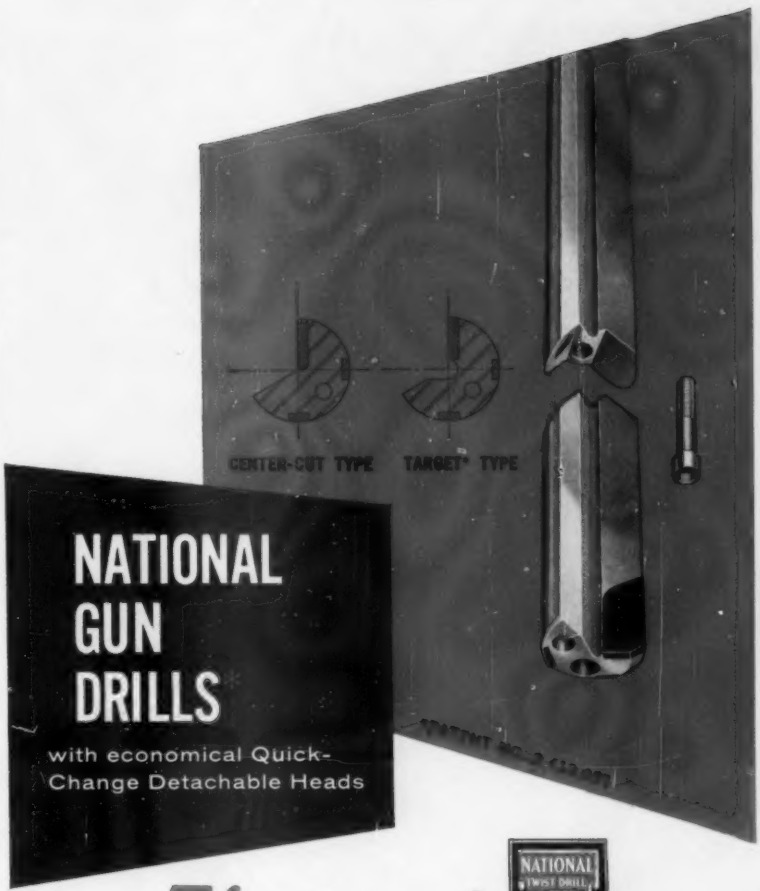
the infiltration of air into the muffle. Known as Type RDT15-620A20, the furnace has a 6-inch-ID Inconel muffle, a 20-inch-long heat chamber and a 20-inch-long water-jacketed cooling jacket. Its maximum heating temperature is 2000 F.

Lindberg Engineering Co., 2450 W. Hubbard, Chicago, Ill. **Circle 457**

USE READER SERVICE CARD ON PAGE 167 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Two-Speed Transmission Controls Torque

This two-speed electric gear transmission incorporates two electric clutches and an electric brake for high-speed rapid traverse, low-speed positioning and consistently accurate stopping. The Electromat Mark I provides remotely controlled speed selection, torque control and braking action which can be integrated into any machine control scheme. Remote torque control is achieved by rheostats in the clutch and brake control lines. Since the



Quick-Change Detachable Heads, an exclusive, patented feature of National Gun Drills offer maximum production economy, assure less drilling downtime. Available on both Center-Cut and Target type Gun Drills larger than 17/32" in diameter, the Quick-Change design allows resharpening or replacement without removing the drill shank from the machine.

Target Gun Drills permit straighter, deeper drilling to closer tolerances. A solid core is formed that acts as a continuous center guide in the hole being drilled with a resulting increase in accuracy.

Center-Cut Gun Drills are recommended for peak efficiency on certain applications such as blind-hole and interrupted-hole drilling.

Call your National Distributor for complete information. Or, write for our Gun Drill Manual.

NATIONAL TWIST DRILL & TOOL COMPANY

Rochester, Michigan, U.S.A.

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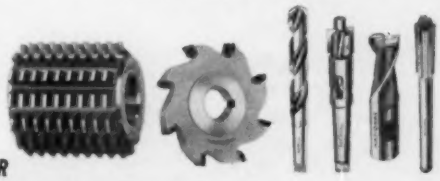

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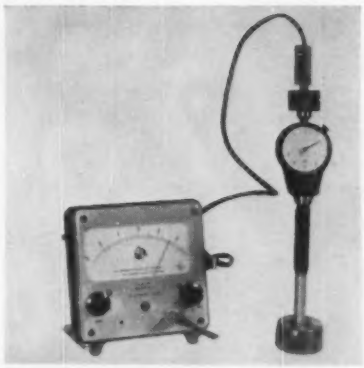
clutches and brake can be operated directly from snap action switches, relay timing errors are eliminated. The unit is available in horsepowers ranging from 1 to 40.

Electromatic, Inc., 4169 Pearl Rd., Cleveland 9, Ohio. **Circle 458**

USE READER SERVICE CARD ON PAGE 167 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Gage Combines Range And High Accuracy

A solution to gaging problems in applications where large amounts of stock must be removed, yet dimensions must be periodically checked, is offered by this measuring instrument. It is a combination mechanical dial indicating gage, which provides ample range for deep cuts, and electronic indicator which automatically becomes activated as finish size is approached. The indicator is battery operated and the gage

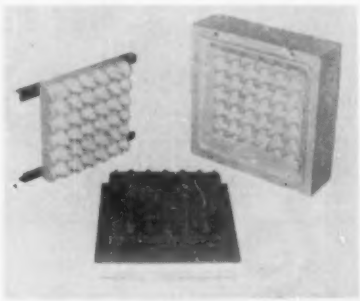


is completely portable. The model illustrated will gage bores from ¼-inch ID up.

Boice Gages, Inc., Hyde Park, N. Y. **Circle 459**

Mold Material Replaces Plaster

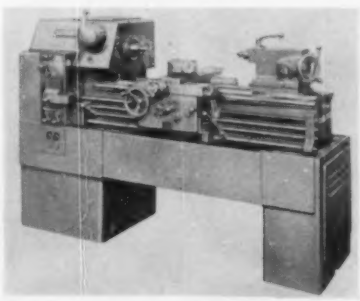
Shown here are molds and models produced by the epoxy-sand technique. The technique uses an epoxy compound mixed with silica sand. The room-temperature-cured material provides



tough, dimensionally stable molds and models costing less, on a material and labor basis, than plaster. In addition, drying and sealing are not required. Molds or models that won't crack, peel, chip or gouge are ready for use in 2 to 4 hr.

Hysol Corp. **Circle 460**

Dual-Drive Toolroom Lathe



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This dynamic new line of completely transistorized gages gives you two-millionths accuracy at unbelievable prices! Included are interchangeable gage heads and amplifiers for surface plate and height gage work, and bench inspection . . . surface finish gage, ultra-sensitive comparator for metrology use, cylindrical grinder control and transducer calibrator. Smaller, lighter, more versatile and dependable . . . Techni-Rite units are available off the shelf in 110 v AC or self-contained battery models. **Priced as low as $275. for a complete gaging system! Write for further information and prices.**

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A few select representative territories are still available

PICTURED ABOVE ARE.

Front Row (l to r) Minicom Height Gage with Model M8B-B Amplifier; Minicom Bench Comparator with Model M4B-A Amplifier.

Middle Row (l to r) Microchecker for calibrating transducers; Pulcom Cylindrical Grinder Control.

Back Row (l to r) Surfmaster surface finish gage; Delcom ultra-sensitive comparator for metrology use.

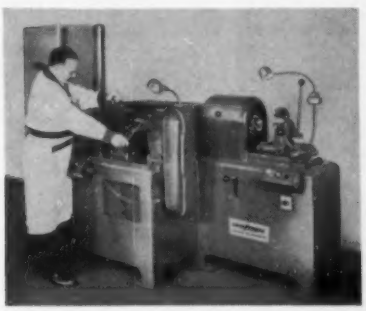
Use Reader Service Card, CIRCLE 120

Among the features of this dual drive, 5-hp lathe are apron reverse to leadscrew and single lever selection of 16 speeds from 31 to 2400 rpm. Forty-eight feed and thread changes are available through the totally enclosed quick change box. A dial at the end of the spindle provides convenient indexing for chasing multiple threads. The machine has a built-in horsepower indicator.

R. K. LeBlond Machine Tool Co., Cincinnati 8, Ohio. **Circle 461**

Machine Flares Metal Tubing

Tubes with outside diameters from ⅜ to 1½ inches and wall thicknesses from 0.028 to 0.049 inch can be trimmed, squared, chamfered and flared

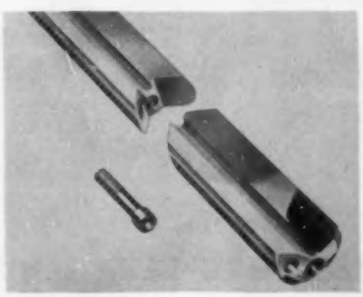


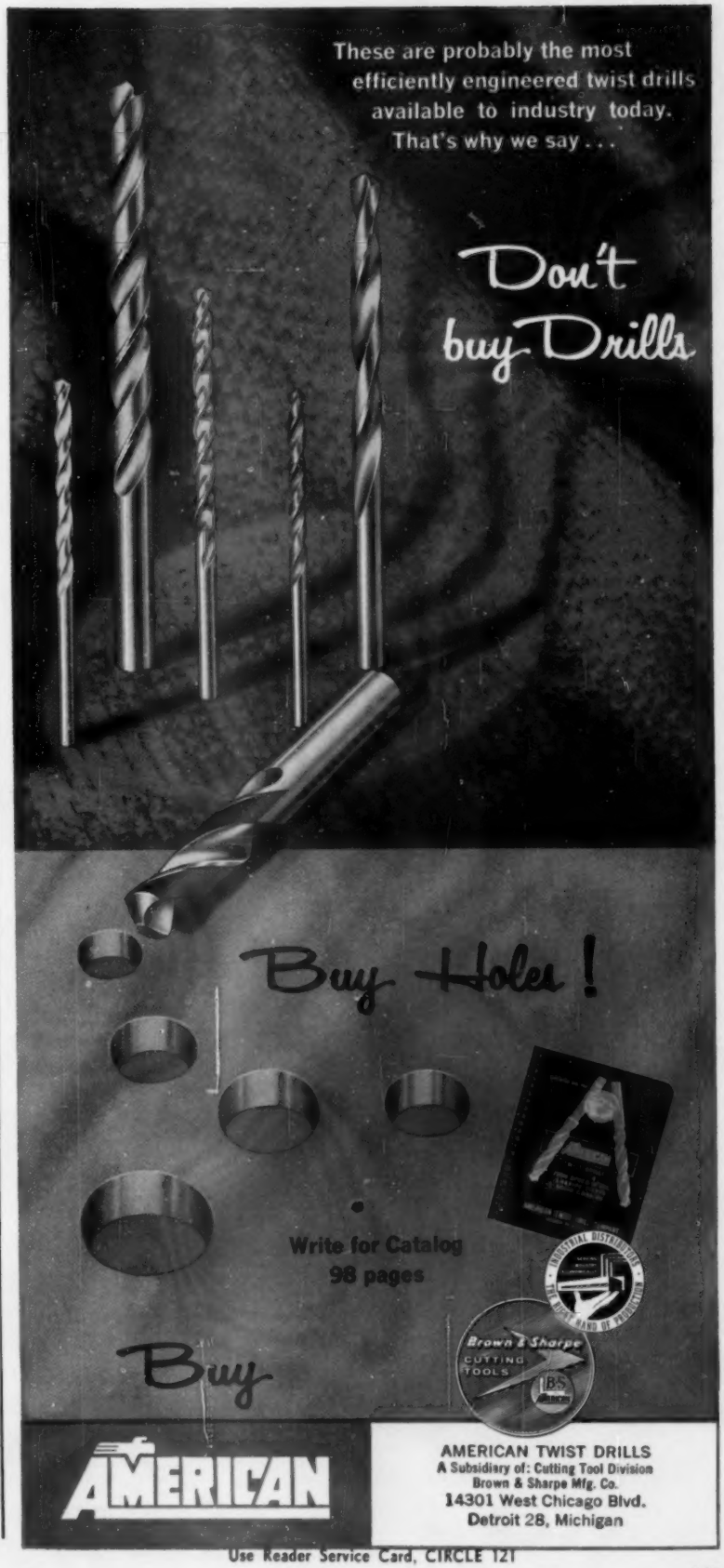
with this machine. It has two-station operation. One station trims and squares the tube end and chamfers both the inside and outside diameter. The other flares the tube. The machine has an electronic speed control system for properly handling aluminum, mild steel, stainless steel, brass, bronze, copper and exotic metals.

Progressive Welder and Machine Co., 915 Oakland Ave., Pontiac, Mich. **Circle 462**

Gun Drill Head Is Detachable

Shown here is the quick-change detachable head used in a line of gun drills. The detachable design permits quick, easy replacement and resharpening of the cutting head without removing the shank from the machine.

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Detroit 28, Michigan
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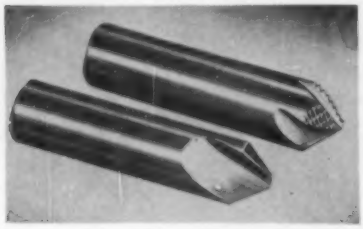
Tool inventories are also reduced, since a single shank accommodates several cutting heads. The head is joined to the shank in a V-assembly by means of a socket head capscrew.

National Twist Drill & Tool Co., Rochester, Mich. **Circle 463**

Countersinking Tools Make Smooth Seats

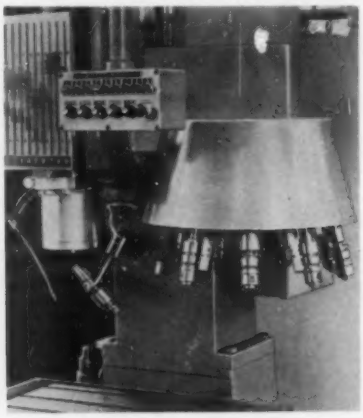
Shown here are a multiflute chamfersink and a monoflute countersink. The chamfersink is designed for chamfering and light countersinking of nearly all materials. The multiflute type teeth were originally designed for countersinking plastics but will work equally as well in ferrous and nonferrous materials. The monoflute countersink countersinks seats in a large range of materials including the exotic metals. Both tools are available with 60, 82 and 90-deg angles.



Dixie Tool Industries, Inc., Bridgeport, Mich. **Circle 464**

Unit Makes Tool Changes in 5 Sec.

Shown here is an automatic tool changer for drilling and tapping machines. This tape-controlled unit makes tool changes in 5 sec. It carries nine different cutting tools which can be manually selected during setup. In typical operation, the cutting tools are held in adapters and seated in individual storage positions in the rotating matrix. At the beginning of the operation, the adapter holding the tool for the first operation is clamped into the nose of the drill spindle automatically. When a tool change is signaled by the tape, two pneumatically controlled fingers grip the adapter in the spindle. The fingers then seat the adapter and tool in the original storage position and the matrix rotates until the next tool comes into position where the fingers can grip it.



Edlund Machinery Co., Dept. A, Cortland, N. Y. **Circle 465**

Tap Chuck Has Long Life, High Accuracy

The Model '09 tap chuck combines concentricity within 0.0005 inch TIR with a positive drive device which eliminates tap slippage. The driver consists of a slotted bar free to shift within the body of the tap chuck. Setscrews at each end of the slotted bar grip the

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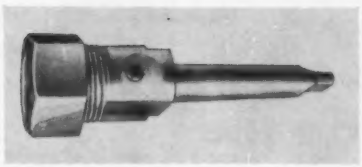
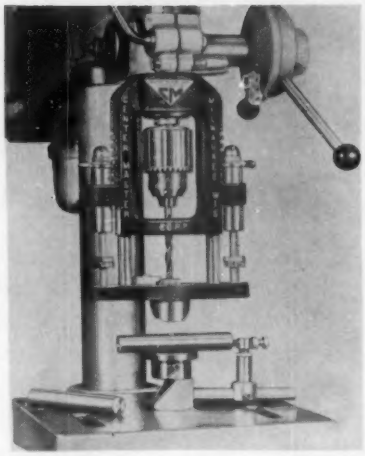


square shank of the tap in the slot. The chuck is available in three sizes for accommodating taps from zero to 1½ inches.

Erickson Tool Co., 34350 Solon Rd., Solon, Ohio. **Circle 466**

Attachment Improves Drilling Operations

This drill press attachment—the Center Master—offers controlled and uniform operations for drilling, counterboring, chamfering and reaming. It can hold, locate and guide the cutting tool on any round, hexagon or square part. The unit is attached to the quill of any ½-inch drill press. The drill press chuck is located in the center of the unit frame. The drill, reamer or counterbore passes down through a bell-bushing or V-bushing. A 100-lb spring pressure on push rods holds the work in place. The attachment can also



be set up for cutting off burrs or nibs and for off-center and special drilling.

Portage Double Quick, Inc., 1054 Sweitzer, Akron, Ohio. **Circle 467**

Electron Beam Gun Is Self-Accelerated

Model 2025G—an electron beam gun for welding refractory and reactive metals—is self-accelerated and uses electrostatic deflection for moving the beam within a 3-inch-diam circle. The gun can be operated in stainless steel bell jars or in larger chambers for production work. It is mechanically moved in the vacuum. Rated at 20 kv, 5 kw, the gun can be used for evaporation in thin film deposition, button melting and zone refining.

High Vacuum Equipment Corp., 2 Churchill, Hingham, Mass. **Circle 468**

Titanium Carbide Tools Permit High Speeds, Feeds

These throwaway and regrindable inserts are made of Grade 3-AT titanium carbide. They can be used in cutting most steels, stainless steels, cast iron and nonferrous material. Titanium carbide can be run at higher surface feeds and speeds than conventional carbide, thereby improving surface finishes and producing accurate work in less time. Size control with closer tolerance limits and repetitive accuracy results from long cutting-edge wear resistance.

Willey's Carbide Tool Co., 1340 W. Vernor, Detroit 1, Mich. **Circle 469**

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BUTTERFIELD
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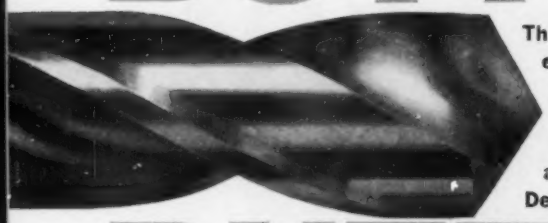

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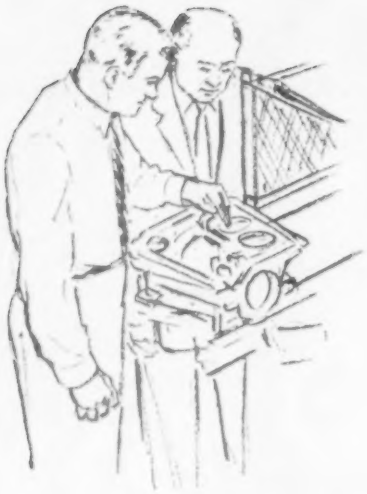
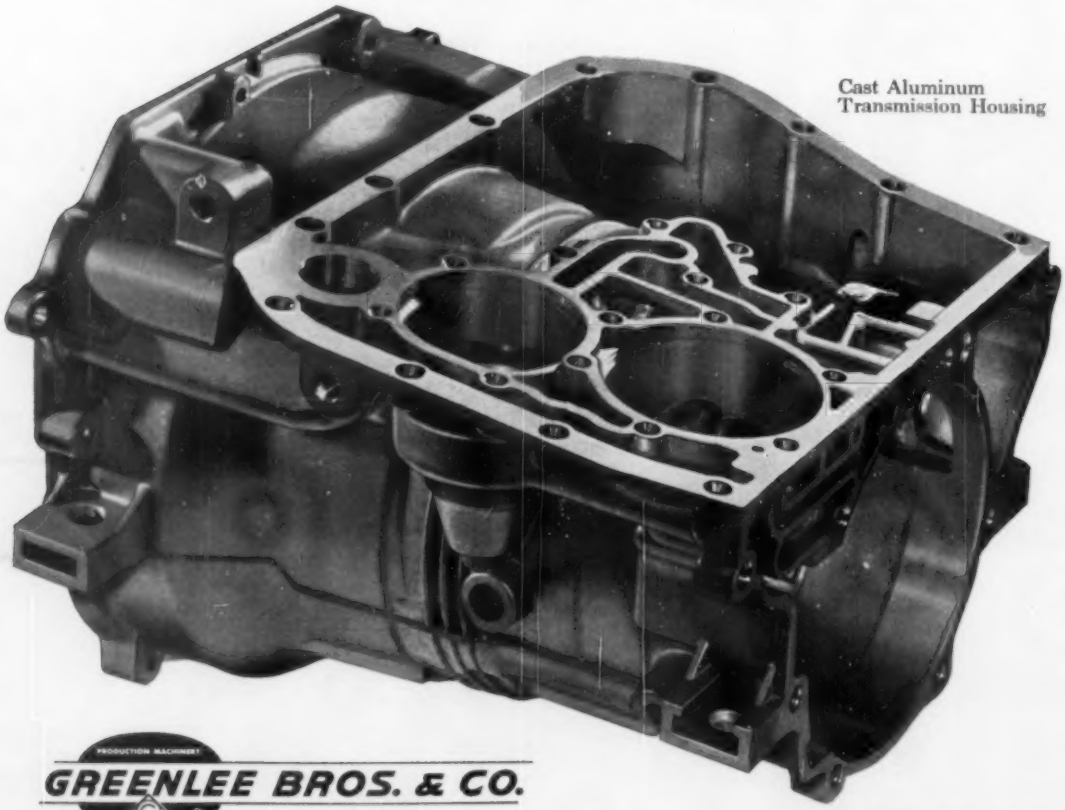
COOPERATIVE APPROACH
to functional part design saves dollars on the transfer line



Tool engineers and product designers know that every functional part must be designed for economical manufacturing as well as function. That's why they welcome the suggestions of Greenlee engineers — *before* the design is finalized. Problems of handling, locating and positioning are more easily solved. In many cases Greenlee cooperative engineering has saved thousands of dollars in capital equipment and reduced unit costs. Some of the largest users of mechanized production equipment have taken advantage of the helpful suggestions offered by Greenlee engineers. Their thinking is sound . . . respected. Write or call for complete information. Greenlee has a Detroit office located at 2842 West Grand Boulevard for your convenience. The phone number is Trinity 2-3928.



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Men at Work

THREE ENGINEERING appointments for Sunbeam Equipment Corp., Meadville, Pa., have been announced. **John P. Zur** is now vice president of engineering; **Willard Roth,** engineering manager; and **Norman J. Acker,** assistant engineering manager. Zur was formerly chief engineer and Roth, assistant chief engineer. Acker had been president of Mern Industries.

James Kyffin has been made vice president of manufacturing and **Robert F. Dee,** sales manager, for C. A. Norgren Co., Englewood, Colo. Kyffin first joined Norgren in 1955 after employment with the Federal Bureau of Investigation. Dee came to Norgren from Red Jacket Manufacturing Co. where he served for the last three years as vice president of marketing.

John Hassall, Inc., has announced the election of **Edward F. Karnes** to vice president in charge of sales. Karnes has been associated with the Long Island, N. Y., manufacturer for over 30 years. His most recent position was that of sales manager.

Recently named to the post of executive vice president of Ohio Crankshaft Co., Cleveland, is **Richard S. Sheetz** (pictured). Sheetz previously held various management positions with Westinghouse Electric Corp.

Courtlandt S. Gross (pictured), president of Lockheed Aircraft Corp. for the past five years, has been elected chairman of the board. **Daniel J. Haughton** (pictured), executive vice president, has been advanced to presidency of the world-wide industrial complex. Gross has served successively as vice president and general manager, executive vice president and president of the 66,000-employee corporation. Haughton, who joined the Burbank, Calif., firm in 1939, became vice president in 1952.

Management changes at Sibley Machine and Foundry, South Bend, Ind., involve **John E. McIntyre, William H. Voll** and **Philip F. Hahl.** McIntyre, former vice president and general manager, has been elected president. Voll has been elected vice president in charge of sales and Hahl, former controller, has been elected to the position of secretary of the corporation.

John R. Strom, technical director of the Roto-Finish Co., Kalamazoo, Mich., and Ransohoff Co., Hamilton, Ohio, has been promoted to vice president. Before joining Roto-Finish, Strom was a process engineer for Brown-Lipe-Chapin Div. of General Motors and for Eljer Co.

The board of directors of Esco Corp., Portland, Ore., has announced the election of **J. J. Davis** to the presidency of the firm. **Newman Ward,** former president, becomes chairman of the board of directors. **C. F. Swigert, Jr.,** becomes honorary board chairman. Davis has been with the firm for 25 years and was elected to the position of executive vice president in December of 1959.

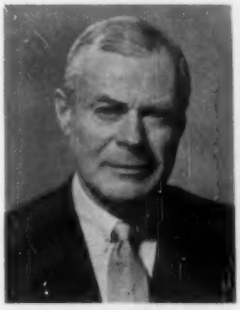
Daystrom, Inc., has announced the assignment of **George V. Gerber** (pictured) as chief components engineer of its military electronics division. Gerber came to the Archbald, Pa., operation from Radio Corporation of America where he was product development engineer. Other previous employment includes General Motors Co.

New chairman and chief executive officer of Borg & Beck Div. of Borg-Warner Corp., Chicago, is **Harold Nutt.** He will be succeeded in his previous position by **James F. Beré.** Nutt joined the firm as director of engineering. Beré's former association was with Axelson Manufacturing Co.

Walter Moryto has been appointed mechanical assistant to the vice president of the American Steel Foundries' transportation equipment division. Moryto, who had been manager of the division's service engineering section, will continue in that capacity in addition to assuming his new duties. He has been with the Chicago concern 39 years.

Charles E. Heitman, Jr., a vice president and member of Bendix Corp.'s administrative committee, has been assigned new executive responsibilities for the corporation's Cleveland Instrument Co., Micrometrical Manufacturing Co. and Industrial Controls Section. Heitman will continue to have jurisdic-

Richard S. Sheetz



Courtlandt S. Gross

Daniel J. Haughton

George V. Gerber

tion over the Bendix Products division-automotive section and Sheffield Corp. and its associated companies. **Arthur C. Omberg,** who has been an assistant group executive of Bendix, has been named a group executive. He will be responsible for the operations of the Mishawaka, Ind., and Hamilton, Ohio, divisions in addition to the aircraft operations of the products division. New general manager of Bendix Products-Aircraft division is **R. E. Whiffen.** He will assume responsibility for directing the design, development and production of aircraft components and systems, propulsion controls, high-temperature materials and rocket and nuclear reactor equipment at the South Bend, Ind., plant. Filling the Ann Arbor, Mich., post of general manager of Bendix Systems division—the position vacated by Whiffen—is **Roy J. Sandstrom.** Sandstrom, formerly vice president in charge of engineering of Bell Aircraft Corp., joined Bendix in 1959. **Louis B. Young** has been named to Sandstrom's former position as general manager of the Bendix Systems division. He joined the systems planning group of Bendix in 1955 and, with the formation of Bendix Systems division, headed the long range planning department.

Smith Thermotronics, Inc., Conshohocken, Pa., has announced that **Robert L. Dyer** (pictured) is new general manager. Dyer served in various posts with Philco, George M. Ewing Co. and National Airoil Burner Co. before joining the manufacturer of thermocouple temperature sensing elements and accessories.

Robert L. Dyer

Warren A. Brown, formerly president of the 158-year-old R. D. Wood Co., has been elected to the board of directors. Succeeding him is **Fred W. Stakelbeck.** Before joining the Florence, N. J., firm Stakelbeck was associated with North American Smelting Co. and Sharpless Corp.

Verson Allsteel Press Co.'s former manufacturing manager, **John Powers,** has been named vice president of operations. **Henry De Matteo** steps up from his position as works manager to fill the vacancy left by Powers in the Chicago concern.

W. H. Schomburg, Jr. (pictured), has been promoted by Dana Corp. to the position of general sales manager. The Toledo, Ohio, company also announced the appointment of **John P. Henson** (pictured) as assistant general sales manager to fill the vacancy left by

John P. Henson

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W. H. Schomburg, Jr.

Schomburg. Schomburg joined Dana in 1945 and has served as sales engineer and product sales manager. Henson's background includes employment with Bendix-Westinghouse Air Brake Co.

Towmotor Corp., Cleveland, has announced changes in its top executive echelon. **C. Edgar Smith,** who has been president since 1951, will assume the post of chairman of the executive committee of the board of directors. **Galen Miller,** executive vice president since 1959, has been made president. **Robert L. Fairbank,** who has headed sales as vice president, becomes executive vice president.

Henry J. Miller (pictured) has been named president and chief executive officer of Hoefer Manufacturing Co., Freeport, Ill. Miller was formerly operations manager of Micronics Div. of Elgin Watch Co. During the offshore

Henry J. Miller

procurement program of the Federal Government, Miller directed training programs for NATO engineers.

I. Dudley Orvis, vice president and general manager Dynex Co., a division of Applied Power Industries, Inc., has been promoted to president. He has also been appointed to the position of vice president of Applied Powers Industries. Associated with Dynex since the company was founded in 1956, Orvis has served as manager of manufacturing engineering and administrative assistant to the president. He has also

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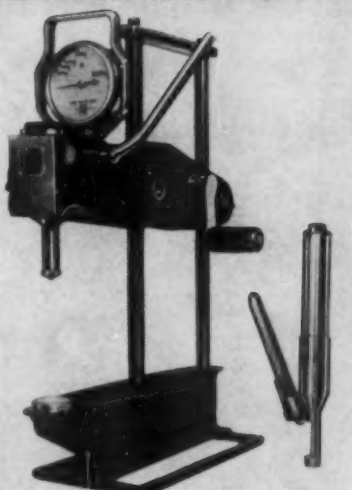

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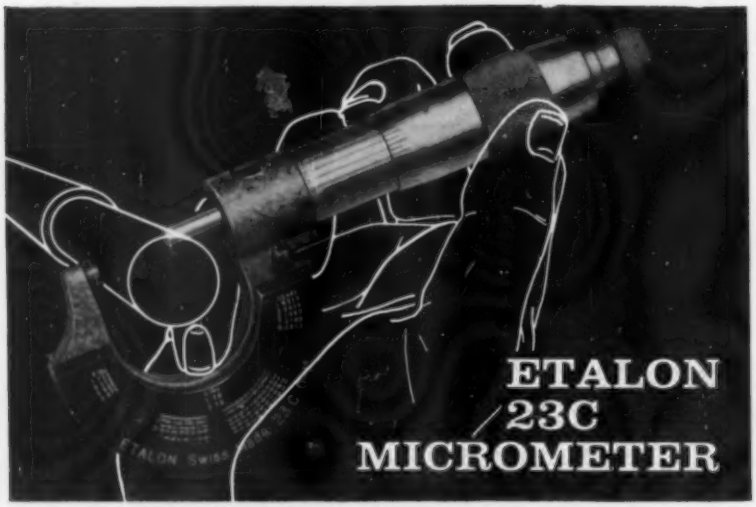

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Men at Work

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John E. Brennan, formerly a vice president of Chrysler Corp., has joined Federal-Mogul-Bower Bearings, Inc., as a vice president of the corporation and general manager of the international division. He will assume responsibility for the firm's present manufacturing operations outside the United States and will assist in the expansion and development of the company's international manufacturing program.

TRW Computers Co., a division of Thompson Ramo Wooldridge Inc., has appointed **Robert E. Richards** district manager. Richards previously was district manager in Atlanta, Ga., for the Control Systems Div. of Daystrom, Inc. He has also been associated with Republic Flow Meters Co. as an applications engineer.

Charles W. Brunstetter has been appointed general manager of Ipsen Industries, Inc., Rockford, Ill. Brunstetter has been with Ipsen since September of 1960. He has been responsible for the development of the refractory metals division and served as manager of the division. In the past, he has been vice president of Astrometals Corp. and has been associated with Thermionic Products Co. He has carried out research and development projects with NASA in the use of refractory metals for space-age requirements.

Appointment of **Hayward F. York** as manager of manufacturing engineering has been announced by Chrysler Corp. In this position, York is responsible for corporate staff activities related to production engineering, plant engineering, nonproductive standards and facility analysis activities. He has served on the corporate manufacturing staff since 1957 when he was appointed chief production engineer.

Newly appointed chief engineer of Baird Machine Co., Stratford, Conn., is **Clarence P. Foreman.** Foreman joined Baird in 1948 and was named chief tool engineer the following year.

Alvin C. Appel, formerly plant engineer, has been appointed works manager at American Tool Works Co., Cincinnati, Ohio. Appel joined the firm in March of 1960. Prior to that he was assistant superintendent at L. G. Freeman Co., plant manager at J. A. Fay and Egan Div. and advanced manufacturing engineer at the General Electric Evandale, Ohio, jet engine plant.

Field Notes

Approval of two revised standards in the fields of materials and metallurgy —each developed and published by the American Society for Testing Materials—has been reported by the American Standards Assn. Replacing standards approved in 1959 are "American Standard Specifications for High-Strength Steel Castings for Structural Purposes (ASTM A148-60), G52.1-1961" and "American Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines (ASTM B16-60), H8.1-1961." Copies of the revised standards are available from the American Standards Assn., Dept. P 249, 10 E. 40th St., New York 16, N. Y., and the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. G52.1 sells for 30 cents a copy while H8.1 has a 50-cent charge.

name changes

The Conneaut, Ohio, manufacturing division of Strong, Carlisle & Hammond Co. has changed its name to Strong. Strong, and the McAlear Mfg. Co. of Chicago, comprise the Specialty Valve, Trap & Controls Div. of White Sewing Machine Corp., Cleveland. Products manufactured and sold by Strong include steam traps, control valves, strainers, separators and blow-down systems used in the steam, air, gas and hydraulic fields.

new activities

Burroughs Corp., Detroit, has announced its entry into the punched card electronic computer business. Ray R. Eppert, president, said the company's program includes a new family of four solid state computer systems, an expanded customer training program, a sizeable increase in the company's U. S. data processing sales and technical support force, and a manufacturing program that will utilize resources of four plants in Detroit and Pasadena, Calif.

E. I. du Pont de Nemours and Co., Wilmington, Del., has acquired from the government of Australia rights for the development of an Australian system of improved chromium alloys for high-temperature applications. Under the agreement, du Pont will have sole U. S. rights to investigate the chromium alloying process and to manufacture the metal if feasible. The company will pay royalties to Australia if commercial production is undertaken. The process was developed by the Aeronautical Research Laboratories and the Defense Standards Laboratories of the Department of Supply.

acquisitions

American Gage & Machine Co., Chicago, has announced the purchase of two companies by its affiliates, Bellwood Mfg. Co. and Laminated Metals. The Bellwood acquisition includes Snow Mfg. Co., builder of high-speed automatic tapping and drilling machines with automatic fixturing, and its property of 58,000 sq ft. The Laminated Metals purchase includes Improved Seamless Wire Co. and its property of 70,000 sq ft in Providence, R. I. Improved Seamless is a 68-year-old company, engaged in bonding precious metals to base metals for use in electronic relay contacts, catalysts and missile work.

Dominion Brake Shoe Co., Ltd., wholly owned Canadian subsidiary of American Brake Shoe Co., has acquired a minority interest in Jarry Hydraulics, Ltd. Jarry is Canada's leading producer of aircraft landing gear and steering systems and a major manufacturer of other airborne hydraulic equipment. According to Kempton Dunn, president of American Brake Shoe Co., acquisition of the interest in Jarry will give Dominion Brake Shoe a broad base in the fields of aircraft and missile hydraulic systems. Two American Brake Shoe divisions currently manufacture airborne hydraulic products in the United States. Dominion Brake Shoe will bring Jarry an important line of industrial hydraulic equipment similar to that now manufactured by American Brake Shoe in this country. Both Dominion and Jarry have their headquarters in Montreal. American Brake Shoe is located in New York City, New York.

Lockheed Aircraft Corp., Burbank, Calif., has announced an agreement with Petro-Tex Chemical Corp., Houston, Tex., to acquire complete ownership of Grand Central Rocket Co. Lockheed already has a 50 percent interest in Grand Central, acquired early in 1960.

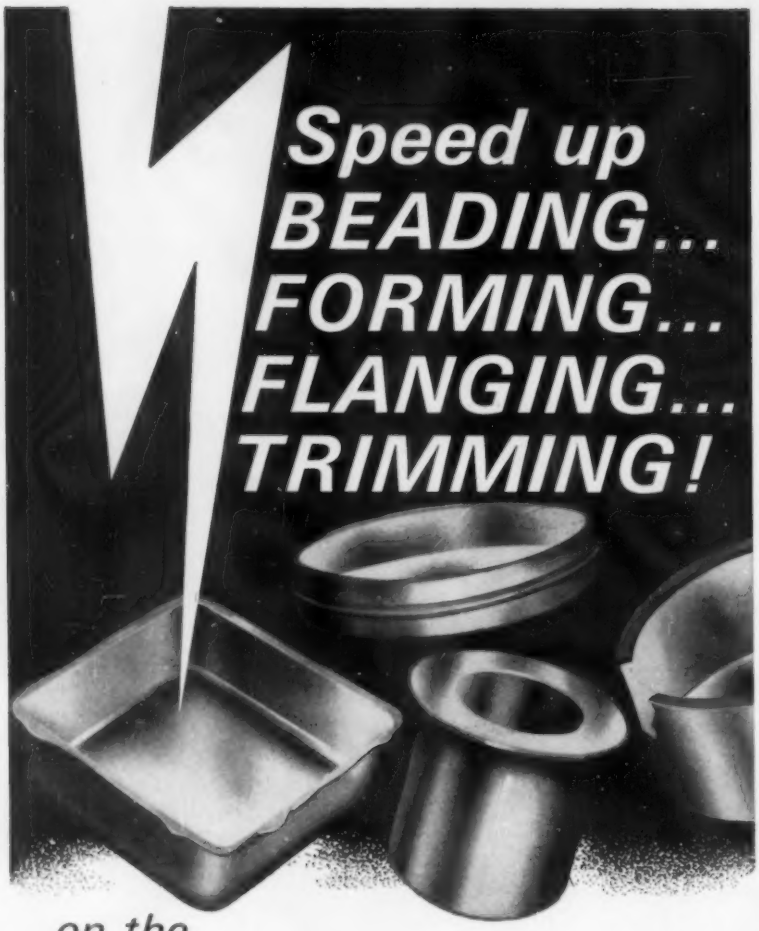
Tannewitz Works, Inc., of Grand Rapids, Mich., which for 71 years has been engaged in the manufacture of sawing machinery, was recently purchased by Marvin R. Elenbaas from the principal stockholder and former president of the corporation, Carl E. Tannewitz. Elenbaas has had over 14 years of experience in the area of toolmaking and special machinery manufacture. For the past eight years he has served in supervisory capacities with General Motors Co. and Lear Inc. Since 1955 he had been superintendent of parts and fabrication for Lear. Oliver DeGroot will remain with the new organization in his former capacity of vice president and factory manager.

new companies

National Tool & Die Inc., has acquired the Mardigian Blvd. plant at 1130 W. Grand Blvd., Detroit, where complete die construction facilities are available for large and small automotive dies, jigs and fixtures. Chester W. Bissell is president of the company and John Cox, vice president and general manager. Both men are affiliated with the Detroit Kellering Co. and Automation Machine Div. The three facilities under common management will offer a complete facility for the manufacture of tooling equipment.

moves

Precision Castings Corp., an affiliate of Detroit Industrial Products Corp., has moved into larger quarters at 21620 Coolidge, Oak Park, Mich. New induction furnaces with melting capacity up to 3000 lb in a single heat wave have been installed in the 10,000-sq-ft plant, along with other special equipment used in the production of Shaw Process pre-



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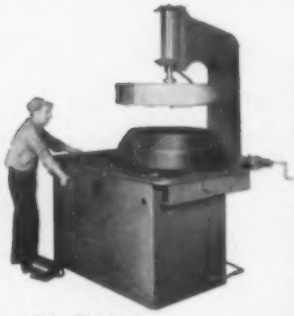

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cision castings. The company is currently producing forging and stamping dies, die-casting dies, bottle molds, metal foundry patterns, plastic molds and extrusion dies and production lots of parts such as impellers, cams and gears.

Arthur A. Crafts Co., Boston tool and gage manufacturer and distributor, is constructing a new plant in the Waltham Research and Development Park in Waltham, Mass. The company's general offices and New England sales division will also be located in the 40,000-sq-ft facility. Plans call for completion early in 1962.

The Detroit facilities of A. F. Holden Co., manufacturer of heat-treating furnaces, salt baths and process equipment, have been transferred to the company's newly erected headquarters at Milford, Mich. The Milford plant, located at 2195 S. Milford Rd., has been expanded to accommodate offices for engineering, sales and administrative personnel; a research laboratory; and new manufacturing facilities. Transfer to Milford from the firm's present location at 14341 Schaefer Hwy. was completed September 30, 1961.

expansions

Bay State Abrasive Products Co., Westboro, Mass., has selected the Duchy of Luxembourg as the site of their third manufacturing subsidiary. Excavation for the new subsidiary in the Commune of Steinsel started near the end of October. Actual grinding wheel production will commence within nine months. The basic lines will include vitrified, Resinoid, reinforced Resinoid and diamond abrasive products.

Final approval by the government of India has been given to a joint venture of Harris Mfg. Corp., Chicago, and K. S. Malik, New Delhi, India, to set up a tool and die shop in that city. Total investment in the project will run $200,000 with Harig retaining a 50 percent interest. Harig is supplying the equipment and know-how to produce tools and dies; surface grinders; drill press vises; drill point sharpeners; and end mill grinding fixtures. The new plant in India will serve the Asiatic market.

High Precision Equipment, Ltd., Bletchley, Bucks, England, has been named as a manufacturing licensee by Baird Machine Co. The agreement between the

two companies involves the right of High Precision, Ltd., to manufacture Baird chucking machines and to distribute them throughout the British Commonwealth and the European Common Market countries. High Precision is a subsidiary of Associated Engineering Group, a holding company which controls over 13 manufacturing firms. The exchange of technical information and personnel between the Stratford, Conn., firm and H.P.E. is expected to begin this fall. Current plans call for the first British-made Baird chuckers to be ready for the market before the end of 1962.

association news

The National Fluid Power Association is establishing an annual award to recognize outstanding individual achievement in the field of fluid power. Approved at the recent meeting of the association and its board of directors, the award will be conferred for the first time in 1962. It will recognize contributions to the field of hydraulic or pneumatic power in areas of engineering, research, development, design, sales, production, invention and publications. Nominees need not be members of NFPA or affiliated with member companies. Nominations may be made on forms available from NFPA headquarters at 5595 N. Hollywood Ave., Milwaukee, Wis., and must be submitted by April 30, 1962, for consideration for the 1962 award. Selection of the winner will be made by a committee representative of the fluid power industry, engineering education and research, and publishers of technical materials related to fluid power and its applications.

awards

Gerald Weiss, assistant professor of electrical engineering at Polytechnic Institute of Brooklyn, has been awarded the CompuDyne Foundation in Industry scholarship. Selection of Weiss was made by the Foundation for Instrumentation, Education and Research, Inc. In addition to receiving the presentation of the $1000 award, Weiss spent a four-week period at CompuDyne Corp., in Hatboro, Pa., studying the application of the most recent theory in instrumentation and automatic control and gaining at the same time practical experience on high performance electromechanical hydraulic servomechanisms. Weiss has made important contributions to the studies on the stabilization and compensation methods for hydraulic servos having high dynamic loads and large oil volumes.

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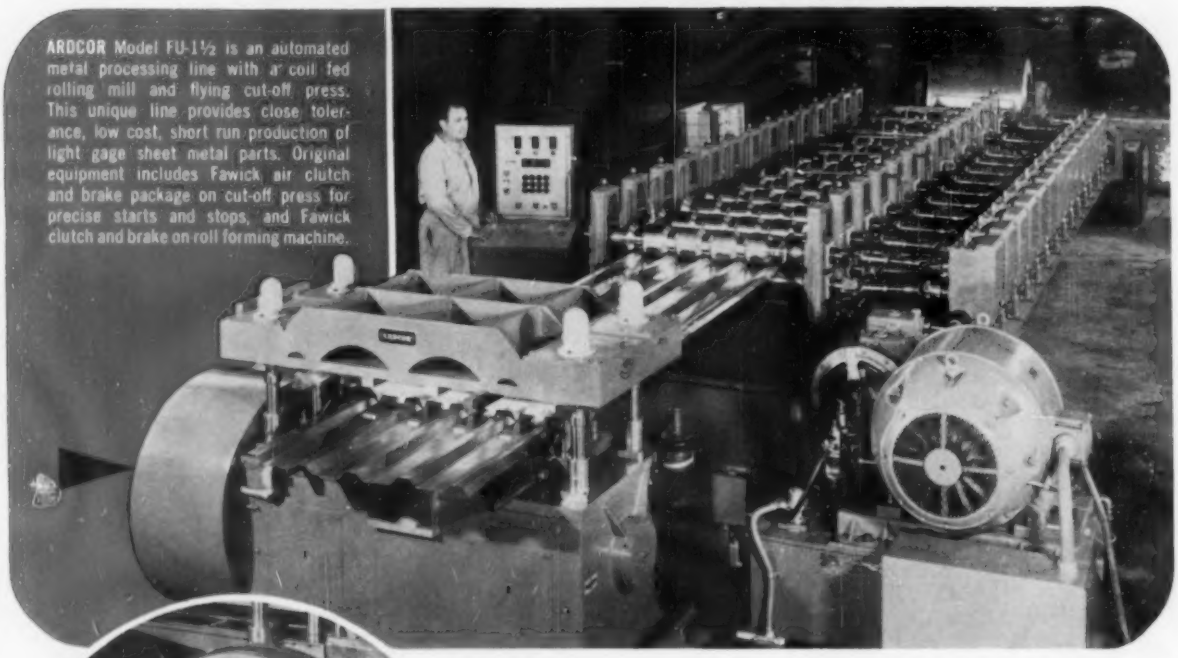

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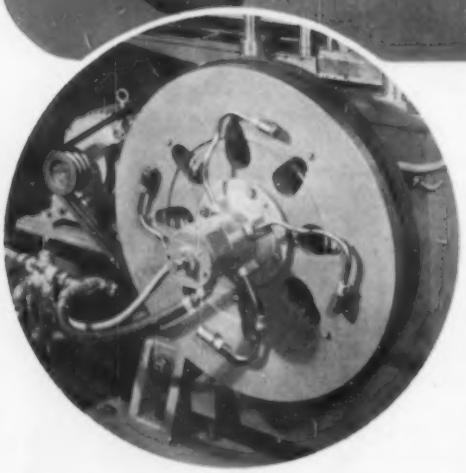

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NEW LITERATURE

manufacturing data you can use

Two new issues of the "Power Metallurgy Quarterly" discuss advances made in the field and powder metallurgy's importance as a defense production tool. Specific applications and case histories are covered. Write to the Metal Powder Industries Federation, 60 E. 42nd St., New York 17, N. Y., for your copies . . . Standards on miniature screw threads and screws are listed in a bulletin. Threads smaller than 0-80 and sizes as small as 0.0118-318 are covered. J. I. Morris Co. **(Circle 501)**

Automation, Mechanization

Four models representative of a line of multiple transfer presses are described in a folder. Baird Machine Co. **(Circle 502)** . . . Included in a booklet describing two new indexing units is information on cams and dial plates and on machine bases, motors and electric timers. A comprehensive load rating table; load calculation methods; a nomogram for weight and moment of inertia calculations; and a torque rating table are also presented. Standard Tool & Manufacturing Co. **(Circle 503)** . . . Digital process controllers count pulses from all types of sensing devices and control various functions of other equipment when a preset count is reached. They provide a range of zero to above 180,000 counts per minute with instantaneous reset. Louis Allis Co. **(Circle 504)** . . . In addition to portraying tool control boards, a catalog shows a three-board unit wherein the central board contains a master electrical system, counters and a revolving flasher light which works simultaneously with warning lights on all boards for different operations. Royal Design and Manufacturing, Inc. **(Circle 505)**

Boring, Drilling, Tapping

Available in straight, 90-deg and radius-tooth form models, a keyseater cuts single or multiple, straight or tapered, internal keyways. It is suited to small quantity orders where bores and keyways vary considerably. Davis Keyseater Co. **(Circle 506)**

Casting, Molding

A four-page brochure tells of a company's entry into the field of aluminum alloy investment castings. Misco Precision Casting Co. **(Circle 507)** . . . An 18-page booklet describes plaster mold casting and planar investment casting and relates how both processes can be combined to overcome important limitations of either process alone. Atlantic Casting and Engineering Corp. **(Circle 508)**

Cleaning, Plating, Painting

Vacuum metallizing—a method of depositing a coating on a prepared surface—eliminates hydrogen embrittlement and increases corrosion resistance. It is less expensive than electroplating because it needs no buffing operation and because special tanks and plumbing for handling corrosive and noxious chemicals are unnecessary. F. J. Stokes Corp. **(Circle 509)** . . . Vapor, spray or immersion methods of degreasing are discussed in relation to various applications in a 16-page booklet on trichlorethylene degreasing equipment. Uddeholm Co. of America, Inc. **(Circle 510)** . . . How to apply four forms of hard-surfacing materials is discussed in an eight-page bulletin. Kennametal Inc. **(Circle 511)** . . . Paint, enamel and other coatings can be applied to small parts with a 100 percent air-powered centrifugal enameler. Leon J. Barrett Co. **(Circle 512)** . . . Temperatures in excess of 30,000 F can be generated by plasma torch and spray equipment. Coatings of refractory metals such as tungsten, or ceramics, and cermets can be sprayed in much the same manner as paint is sprayed from a spray gun. Precision Metal Products Corp. **(Circle 513)** . . . "Industrial Metal Cleaning" discusses the factors involved in selecting a cleaner and cleaner equipment and compares the advantages offered by various types of cleaners. Nox-Rust Div., Daubert Chemical Co. **(Circle 514)** . . . Fourteen pulsating magnet models as well as three pneumatic and hydraulic units are discussed in a 12-page bulletin. The vibrators are designed to promote the free flow of bulk materials through bins, hoppers and chutes. Syntron Co. **(Circle 515)** . . . The difference between high velocity and regular velocity processes is explained in a brochure describing a line of wet blast units. Pressure Blast Mfg. Co., Inc. **(Circle 516)**

This section is prepared as a quick guide to manufacturer's information on new machines, tools, tooling, manufacturing equipment and materials of all kinds. The "Circle Numbers" appearing after each item are keyed to the Readers Service Card elsewhere in this issue.

To receive the item you want, just circle the appropriate number on the card.

If you want information on items not listed here this month, write to New Products Editor, THE TOOL AND MANUFACTURING ENGINEER, 10700 Puritan Ave., Detroit 38, Mich. Your request will be handled promptly.

Cutting Tools

With Grovall tooling, it is possible to groove near shoulders or machine chucks and to face and undercut shoulders with throwaway tools. U. S. Tool & Cutter Co. **(Circle 517)** . . . "Carbide Tool News" presents capsule-form news stories on tool developments, production methods and tool materials for milling, turning and boring operations. Address your request on company letterhead to Wesson Corp., 1220 Woodward Heights Blvd., Ferndale 20, Mich. . . . A brochure describes the features, types and sizes of a line of high-speed steel, decimal-width milling cutters. QT Tool Co. **(Circle 518)** . . . A new series of throwaway insert face mill cutters for rough, semirough and finish milling brings the economy of throwaway inserts to all milling operations. Vascoloy-Ramet Corp. **(Circle 519)** . . . Rigidcut inserted blade milling cutters are designed for general purpose or high production milling operations and are available in two styles—fine pitch for high-speed, fast feed milling and coarse pitch for light or medium feed and speed combinations. The Varicut series provides four-way interchange-

ability for plain, full side, half-side and staggered tooth milling. Vascoloy-Ramet Corp. **(Circle 520)** . . . A brochure covers additions and modifications to several lines of screw-on and clamp-on cartridges used with throw-away carbide cutting tool inserts. Microbore Div., DeVlieg Machine Co. **(Circle 521)**

Electric Motors, Controls, Drives

A new proximity limit switch for detection of ferrous and nonferrous materials without physical contact can be used for sorting, counting and inspection and for limiting machine travel. General Electric Co. **(Circle 522)** . . . A 12-page bulletin contains the theory and application of linear variable differential transformers for measuring linear displacements. Military specifications and special differential transformer characteristics are tabulated. Automatic Timing & Controls, Inc. **(Circle 523)** . . . "How Others Do It" contains ideas submitted by plant engineers and electricians showing how they've used snap-action switches to increase production efficiency. Micro Switch, division of Minneapolis-Honeywell Regulator Co. **(Circle 524)**

Fastening, Joining

A booklet pictures various machines used in processing and assembling products such as incandescent and fluorescent lamps, radio tubes, electronic components, typewriter components and razors. Swanson-Erie Corp. **(Circle 525)** . . . Hex head capscrews, made to ASA standards, outperform both hex bolts and hex screws. Neither the hex bolt, made to less strict ASA standards, nor the hex screw, for which there is no ASA standard, is designed for use in a tapped hole. The hex head capscrew is designed for a tapped hole as well as for a nut and thereby offers the additional advantage of inventory simplification and consequent lower inventory costs. Standard Pressed Steel Co. **(Circle 526)**

Finishing, Grinding

A new burnishing machine strengthens parts at critical fillets by cold-working and compacting the surface. Michigan Tool Co. **(Circle 527)** . . . Shown in a bulletin covering a line of air-cushioned vibratory finishing equipment is a new fully automatic continuous process machine designed to handle large quantity production requirements. Another section of the bulletin is devoted to accessories such as hoist pans, media bins, centrifugal dryers and screen separators. Pangborn Corp. **(Circle 528)** . . . Safety mounted wheel and points for offhand and precision grinding applications are available in standard A, B and W shapes and sizes in four different bonds and in a variety of grain sizes from coarse to very fine. Simonds-Worden-White Co. **(Circle 529)**

Fluid Power

Two bulletins cover a complete line of 2, 3 and 4-way directional control valves in sizes from ½ to 3 inches for pressures up to 3000 psi. Oilgear Co. **(Circle 530)** . . . A 1008-page catalog covers a complete line of centrifugal, axial and mixed flow pumps. Allis-Chalmers Manufacturing Co. **(Circle 531)** . . . Hydraulic power packages containing a pump, an electric motor, valving and a reservoir can be used in practically any hydraulic application. The pump is connected directly to the extended shaft of the electric motor, providing easy installation and operating dependability and eliminating alignment problem. Vickers Inc. **(Circle 532)** . . . Two solenoid valves with a new UL listing are shown in a bulletin. One type is for air, water and steam, while the other is for steam only. J. D. Gould Co. **(Circle 533)**

For { 8-STATION PRODUCTION MACHINING / 1½" BAR AND COLLET WORK / CHUCKING / SINGLE POINT THREADING

Costs { $7,525.00 FOB Factory Complete with all standard equipment

This is an all new 1½" bar capacity ram type turret lathe with power feeds to all 8 working stations . . . that in addition to bar and collet work also has the versatility to do chucking, and when needed, single point threading. Powered by a 5 h.p., two-speed, geared motor, the new Sheldon 3 R turret lathe provides 16 spindle speeds, 60 different feeds to the carriage and cross-slide, and 180 different feeds to the ram turret.
The turret itself is ruggedly built and accurately machined to provide close tolerance indexing. And for complete ease of operation, it is put under power by simply pressing a push button on the control panel.

This new 3 R Sheldon is completely equipped with two-speed motor and electrical controls, coolant system and splash guards, LO spindle nose, large satin chrome dials and hardened bed ways. It also provides an additional cost saving feature—each turret face is drilled and tapped for your standard flange type tooling as well as being bored for your standard 1½" shank type tooling.
For versatile, accurate machining in either long or short runs, the new Sheldon 3 R provides the answer to low investment cost with high profit operation.

New SHELDON
3R-TURRET LATHE

Write for bulletin with complete specifications and tooling data

SHELDON MACHINE CO., INC.
4224 N. Knox Ave. • Chicago 41, ILL.
Builders of 10", 11", 13", 15" Sheldon lathes, Sheldon Milling Machines, Sheldon Shapers and Sebastian Geared Head Lathes

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Lathes
Seven types of lathe turrets are described in a catalog written to help the user analyze his requirements and select the correct turret, adjustable center or magnetic base tool. Enco Manufacturing Co. **(Circle 534)**

Lubricants, Coolants
Ten grades of a general-purpose lubricating oil for extremely wet conditions can be used for both once-through and continuous-use applications on plain and antifriction bearings, linkages, cams, gears and gearboxes, compressors, cylinders and crankcases, hydraulic systems, and low-speed diesel engines. Sun Oil Co. **(Circle 535)** . . . A 32-page booklet discusses properties and types of lubricating grease and summarizes the principles and rules for selecting and applying it. Bardahl Manufacturing Corp. **(Circle 536)** . . . Typical applications of a grease type lubricant containing a high concentration of molybdenum disulfide are given in a bulletin. Alpha-Molykote Corp. **(Circle 537)**

Materials
"Alcoa Aluminum Screw Machine Stock" contains approximately 170 pages of general information, data on properties and tolerances, estimating information and tooling and operating data. The booklet is written to aid designers in specifying materials, and operators in attaining correct machining practices. Aluminum Company of America. **(Circle 538)** . . . Procedural recommendations for controlled cooling of hard-surfacing overlays when applied to martensitic 400 series stainless steels are given in a technical data sheet. Wall Colmonoy Corp. **(Circle 539)** . . . Twenty-one constant force extension springs deliver the same force at any deflection with no spring rate or gradient. Hunter Spring Co. **(Circle 540)**

Milling
Sliding head type milling machines are available as either plain or universal type machines and have 3-hp spindle drive motors. Brown & Sharpe Mfg. Co. **(Circle 541)**

Pressworking
The "Danley Die Jester"—published eight times a year—announces product and manufacturing activities and offers tips on how to get the most out of die sets and presses. To add your name to the mailing list, write to Danly Machine Specialties, Inc., 2100 S. Laramie Ave., Chicago 50, Ill. . . . Complete dimensioning and technical information for open gap and column air presses for assembly, riveting, forming, bending and molding applications are given in a bulletin. Hannifin Co. **(Circle 542)**

Sawing
A power metalcutting bandsaw—available as either a portable or stationary model—has an adjustable hydraulic cutting feed control. Covel Manufacturing Co. **(Circle 543)**

Welding, Soldering, Brazing
Portable a-c arc welders with a welding range from 10 to 190 amp for use on 110/120-volt lines are described in a bulletin. Birdsell Products. **(Circle 544)** . . . Case reports describe how one company was able to fabricate a lightweight, mobile diesel pile hammer, with low hydrogen electrodes, with a resultant strength equal to a cast or forged pile hammer; how stainless electrodes and wires were used to fabricate a 34-ft pressure vessel; and how a coal company is getting 400 percent longer life from hard surfacing material for bucket teeth. Electrode Div., McKay Co. **(Circle 545)** . . . "The Welding of Mild and Alloy Steels" contains complete information on specifications, operating characteristics, mechanical properties, applications and other pertinent data on mild steel and hydrogen electrodes. McKay Co. **(Circle 546)**

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INSERTED BLADE
CUTTING
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PRECISION CUTTING JOBS
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MATERIAL: Grey cast iron.
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We want your ideas . . .

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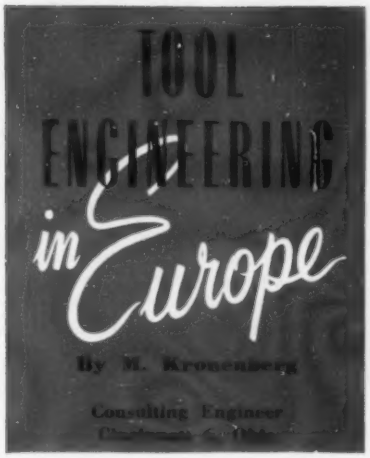
And if your idea is among the best submitted, we want to give you a prize.

How much can you win? What's required to enter? Who does the judging?

Here are the answers:

- **Prizes: First prize, $100; two second prizes of $50; four third prizes of $25.**
- **Honorable Mention Awards: Copies of either the *Tool Engineers Handbook* or the *Die Design Handbook* will be awarded to all close runners-up.**
- **Honorariums will be paid for all entries published—and all worthwhile entries will be published.**
- **Finished drawings aren't required. Sketches that adequately convey your idea are okay. We'll also accept photographs if they're clear and reproducible.**
- **Submit as many entries as you like.**
- **Your entry will be judged by the Editorial Committee on the basis of originality, conciseness and completeness of presentation.**

Send your entries to the Gadgets Editor, THE TOOL AND MANUFACTURING ENGINEER, 10700 Puritan Avenue, Detroit 38, Mich.



Electromagnetic Clutches

Machine tool drives equipped with electromagnetic clutches are a relatively recent development and as yet they are not covered to any great extent in metalworking literature. Hence, Th. Thomsen's survey of the subject, which appears in *Werkstatt und Betrieb*, is of special interest.

Electromagnetically operated multiple disk clutches can transmit large torques despite their small size and they can be remotely controlled. The moment of inertia at the driven end (usually known as the WR^2 in American shop language) can be kept small, which is a desirable feature when accelerating and decelerating machine elements and workpieces.

Thomsen discusses clutches with and without magnetic flux and with and without sliprings. Clutches with magnetic flux can be operated dry; the other types of clutches must be engaged in oil.

Clutches that are engaged in oil may disengage slowly because a hydrodynamic film of oil exists in such clutches. This film must be penetrated and cut by the clutch and the oil must be pressed out of a number of disks. The disks often stick, delaying disengagement.

On the other hand, the oil usually keeps the clutch plates cool, removing about 80 to 90 percent of the generated heat. Oil viscosity, number of speed changes and other variables affect clutch performance.

Thomsen concludes that it is necessary to differentiate between the driving torque (which depends on the number of disks, the coefficient of friction and the normal force), and the transmissible torque, which is about twice as high as the usually quoted driving torque. According to Thomsen, once a machine is running and slip drops to zero, applied torque can be increased 100 percent.

The survey covers actuating time, acceleration and deceleration, and their relationship to flux, voltage and other electrical quantities. The number of engagements and disengagements per minute is discussed, as is circuit opening time. Quantities affecting the working capacity of electromagnetic clutches are also covered in the survey, which presents pertinent mathematical derivations and a 16-publication bibliography.

SOURCE: Thomsen, Th.—"Electromagnetische Lammellenkupplungen, Zusammenfassende Darstellung auf Grund des neuren Schrifttums". *Werkstatt und Betrieb*, Vol. 94, No. 6, 1961, p. 319-326.

Electron Beam Machining

European developments in the field of electron beam machining are discussed by F. Schleich, writing in *Industrie Anzeiger*. He describes one electron beam machine in detail.

Machining is done in a vacuum. The machine table, which moves in the X and Y coordinates, can be rolled out of the chamber through a door. The machine can also be equipped with a rotating turntable that accommodates workpieces up to 8¾ inches in diameter.

The electron beam is, of course, inertia-free, and it is magnetically controlled. The workpiece is usually stationary during machining and is positioned by the mechanically fed table. Optical micrometers permit accurate motion control.

Typical operations performed by the electron beam milling machine include producing holes with diameters of a few thousandths of an inch, surface machining and welding. In one application, the machining of orifices in tools for the production of plastic fibers, intricate shapes with slits only 0.001 to 0.002 inch wide are machined. Carbide and tungsten sheets as thick as 0.020 inch can be "drilled." Holes having diameters from 12 to 20 microinches can be produced in a few seconds.

Due to their low heat conductivity, nonmetallic materials can be machined faster than metals by the electron beam. In general, the heat can be concentrated on a small area without affecting the microstructure of the material.

Sleich says that exposure times of 10^{-4} to 10^{-7} seconds elimate heat concentrations entirely, while exposure times of 1/100 second give deep penetrations, melting the metal for precision welding. Welding can be accomplished on workpieces as thick as ¾ inch. When welding sheet metal, speeds to 2 inches per second can be attained.

SOURCE: Schleich, F. — "Materialbearbeitung mit der Elektronenstrahlmaschine". *Industrie Anzeiger*, Vol. 83, No 53, 1961, p. 981-985.

Gear Bibliography

Titles of 314 articles dealing with gears are listed in an article by H. Glaubitz in *Zeitschrift des Vereins Deutscher Ingenieure*, Vol. 103, No. 6, 1961, p. 265-271, under the title: "Zahnraeder und Zahnradgetriebe."

Included are books and articles in engineering journals from every important industrial country of the world. The subjects include planetary gears, load carrying capacity, standardization, lubrication, noise, measuring methods and tolerances, gear materials, heat treatment, gear cutting, hobbing, milling, grinding, broaching, honing, and the machine tools for the various gear machining methods. Only recent publications (1959-1960) have been considered.

Gear Correction

Although involute gears are almost always corrected, little is known about the most favorable tooth correction—probably because there is insufficient information on the effect of operating conditions and load-carrying capacity.

Writing in *Werkstatt und Betrieb*, I. Mayer describes a method employing dimensionless quantities to determine the various quantities involved in gear correction. The advantage of Mayer's method is that lengthy calculations are not required; also, since dimensionless units are used, it is applicable to both the metric and English systems.

After discussing tooth profile, engagement conditions, tooth matching, power and tooth strength, Mayer derives 128 equations that cover tooth shape factors, slip conditions and distances, tooth interference, overlap, rack and gear, and similar quantities.

With Mayer's method, stresses can be calculated by multiplying a dimensionless quantity by the tooth pressure. An example shows how load-carrying capacity depends on the correction factor and the number of teeth. Admissible torque can be increased by increasing the pitch, resulting in a greater number of teeth. The greatest gain is obtained by a substantial positive correction of the pinion.

SOURCE: Mayer, I.—"Berechnung korrigierter Zahnraeder mit Hilfe des Waelzwinkels tan α". *Werkstatt und Betrieb*, Vol. 94, No. 6, 1961, p. 327-340.

Measurement During Grinding

Electrical induction is used in a Russian device for the continuous measurement of the dimensions of workpieces under cut in a grinding machine, according to a report published in *Technische Zeischrift fuer praktische Metallbearbeitung*.

The device has a U-shaped body with a 35-deg included angle between the legs. No electrical switches or moving parts are needed. Two coils are located inside the body. One is connected to the input circuit, the other to the output circuit. The output circuit contains a

Tiny Bristol socket screw is held by Pegasus Labs Chief Engineer Charles E. Ikerman.

Bristol's Multiple-Spline Socket Screws have

"...far superior staying power"

That's the report we get from Pegasus Laboratories, Berkley, Michigan, manufacturer of high-precision servo valves for guided missiles, tape-programmed machine tools, and a variety of other equipment.

"Not only must our servo valves function exactly right every time," says Chief Engineer Charles E. Ikerman, "but they must do it under a range of operating conditions which impose almost fantastic demands on every part. . . . Not only did Bristol's Multiple-Spline socket screws surpass all the previous ones in regard to maintenance of original adjustment, but that very quality quite naturally produced a significant improvement in the durability and reliability of our servo valves, making them far less subject to failure, and better qualifying them for long service applications."

This experience reflects the almost universal approval we've received from users of the famous Bristol Multiple-Spline socket screw. Superior holding power under shock and vibration, ability to withstand repeated tightening and loosening, and complete immunity from stripped sockets are qualities that users frequently mention.

Bristol manufactures the most complete socket screw line on the market—including industry-standard hex as well as Multiple-Spline sockets—in a range from No. 0 gauge to 1½".

Ask your authorized industrial distributor for complete information on Bristol socket screws. He can help you select the right socket screw for your job, and he carries a wide variety of types in stock for immediate delivery.

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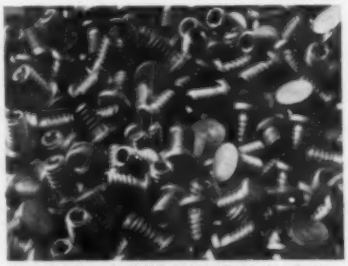

Special No. 2-56 Bristol Multiple-Spline socket screws shown greatly enlarged.

Precision socket screws since 1913...by the makers of famous Bristol Precision Instruments
Bristol's Hex Socket Screws
Bristol's Multiple-Spline Socket Screws
Made in sizes as small as No. 0 in Alloy Steel and Stainless Steel. Cap screws up to 1½" diameter.
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Socket Screw Division
Waterbury 20, Conn.
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voltmeter calibrated in inches. One graduation equals 80 microinches.

Magnetic flux is interrupted at the open side of the body, whose two carbide legs contact the rotating workpiece lightly. When grinding, the air gap between the body of the device and workpiece is increased. The induced voltage is proportional to the distance between the body and the workpiece; hence the dimension of the metal can be read directly from the voltmeter.

SOURCE: *"Messvorrichtung mittels Induktion an laufender Schleifmaschine", Technische Zeitschrift fuer praktische Metallbearbeitung,* Vol. 55, No. 7, 1961, p. 335.

Milling of Turbine Buckets

Times for turbine bucket milling operations have been reduced by two-thirds, using a machine developed in Switzerland and described in the magazine *Technica.*

The entire contour of the bucket is milled in one setup—the inner and outer contours and the leading and trailing edges. Three or four buckets can be machined simultaneously.

Up-and-down motion of the milling cutters is controlled by a master, which can be a handmade bucket or a series of wooden disks clamped together to give the desired shape. Speed of rotation of the buckets is controlled by a roller that contacts the rotating master. This roller is supported by a lever arm. The other end of the lever arm regulates a potentiometer and thus the rpm of a d-c motor. The machine can be equipped with numerical control for fully automatic operation.

SOURCE: "Hydrokopier—Turbinenschaufel Fraesmaschnie mit Rundfraesvorrichtung". *Technica,* No. 16, 1961, p. 1017-1020.

Modular Design for Manufacturing

Applying the principles of modular design to the manufacture of FM and AM radios has resulted in considerable cost reduction and quality improvement, according to H. Kopp, writing in *Werkstattstechnik.* The introduction of printed circuits permitted the mechanization and simplification of operations that formerly required extensive soldering and other manual work. Additional advantages were obtained by replacing welded chassis by frames that are built up using punched strips, channels and similar standard elements. Within four years of the adoption of modular design, rejections dropped 75 percent.

This illustrates the possibility of effecting major manufacturing savings through a study of product design. Often a simple design change can lead to more economical production.

SOURCE: Kopp, H.—"Fertigungsgerechte Konstruktion von Rundfungeraeten". *Werkstattstechnik,* Vol. 51, No. 6, 1961, p. 289-294.

Tool Engineering in Europe

Shearing Forces

The forces involved in the shearing of sheet metal have been investigated by H. J. Crasemann, who describes his findings in *Werkstattstechnik*. Formulas hitherto available to tool and manufacturing engineers are inaccurate and do not take into account a number of quantities included in Crasemann's derivations. His equations include the dimensions of the workpiece, the properties of the work material, the dimensions of the tool (such as the radius of curvature of the cutting edge), the rake angle, lubrication, relative position of work and tool, and velocity of cutting in terms of both magnitude and direction.

All told, there are 15 quantities influencing shearing force. These quantities are combined by Crasemann, using dimensional analysis techniques. Dimensional analysis was used to develop a series of diagrams that can be applied to shearing force determinations without the need for extensive mathematical derivations.

One of the diagrams deals with the determination of the main cutting force for shearing steel, based on six dimensionless quantities composed of the 15 quantities that influence shearing force. An individual diagram is given for each of the dimensionless quantities, which are multiplied by each other to give the main cutting force.

It can be seen from the diagrams published with Crasemann's article that the thickness of the work material has the largest effect on cutting force, which increases with the 1.83 power of the thickness. Increases in rake angle also have a substantial effect.

SOURCE: Crasemann, H. J.—"Kraefte in Scheren". *Werkstattstechnik*, Vol. 51, No. 8, 1961, p. 396-403.

Testing Hydraulic Tracers

Existing methods for determining the speed duplication of hydraulic tracer units are inaccurate and cumbersome and do not permit a clear picture of performance to be obtained as the speed varies.

M. B. Tumarkin has studied the problems involved, tracing them to the fact that testing has been done on a velocity basis, instead of an acceleration basis. He describes the design of equipment and instrumentation for the constant acceleration test method in *Stanki i Instrument*. His tests show that this method is far superior to constant velocity tests.

SOURCE: Tumarkin, M. B.—"Bench Tests of Hydraulic Following Systems". *Stanki i Instrument*, Vol. 32, 1961, p. 3 (Translated into English in *Machines and Tooling*).

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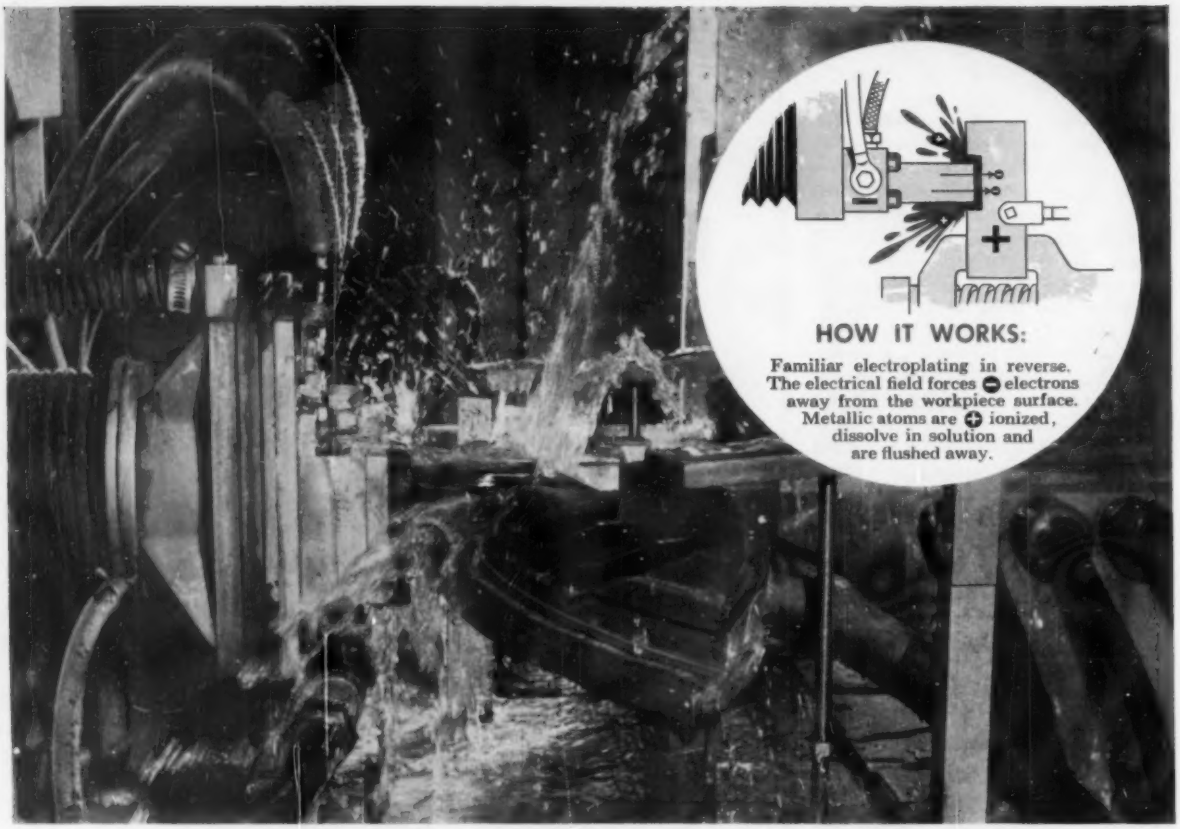
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technical shorts

Magnetic Current Stirs Steel—An induction stirring system developed by Westinghouse Electric Corp. is now being used to agitate molten metal in electric arc furnaces. Called Magnestirrer, the system utilizes magnetic fields to produce turbulence in the melt.

The magnetic field generated is swept through the molten bath of steel, producing a series of eddy currents. The currents, in turn, react with the magnetic field of the stirrer to move the steel. The drive system is a steel mill type, adjustable speed motor.

The entire system is mounted directly under the furnace and, to insure adequate cooling, a forced air system is included. Impending furnace burnthrough is detected by a temperature-sensing device.

Finding the Flaws—Imperfections or discontinuities that formerly were undetectable or undefinable are now being isolated in continuously moving metal with a new flaw detector. Developed by Assembly Products, Inc., Cherterland, Ohio, the detector is able to find such elusive flaws as welds, holes, laminations and other "voids." Utilizing the magnetic field technique, the unit is converted from one application to another through use of replaceable electronic modules.

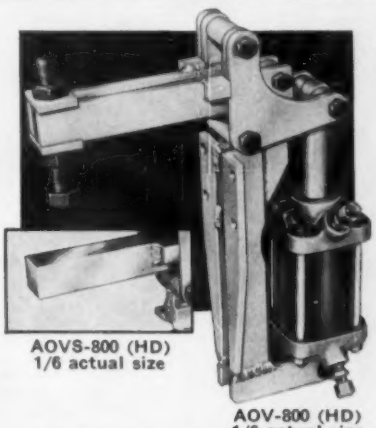
Hughes Develops Ion Engine—Development of an experimental ion engine by the Hughes Aircraft Co. is bringing manned spacecraft travel a step closer to reality. Special characteristics of an ion engine are its economy of operation and the tremendous speeds at which it will travel. Particularly useful in missions where a modest thrust will be required over prolonged periods, the ion engine will use from 20 to 30 times less fuel than a conventional chemical rocket and speeds will be in the order of 2,000,000 miles per day.

Primary source of energy for the ion engine will be a nuclear reactor, the energy from which will be converted to electricity through a heat exchanger and electric generator. The propellant used in this type of engine is cesium, an element selected because of its ease of ionization.

In use as a propellant, cesium is stored in a reservoir from which cesium vapor is diffused through a hot tungsten element. Passage over the element causes ionization of the vapor which then passes through a system of electrodes. Voltage applied at this point accelerates the ions to high velocity.

Actual thrust developed by an ion engine is weak in comparison to that of a chemical rocket engine. Therefore, escape velocity of the missile will be established by propelling devices other than the ion engine. The value of the engine in space technology is that it will be able to function for years. Its thrust, however small, when developed continuously will build up enormous speeds in the missile.

New Ferroboron Developed—Development of a new low-carbon ferroboron has been announced by Vanadium Corp. of America. Added to stainless steels for nuclear applications, it materially increases thermal neutron absorption. It is also used as an intensifier.



AOVS-800 (HD)
1/6 actual size

AOV-800 (HD)
1/6 actual size

DON'T SEND A BOY TO DO A MAN'S JOB—
SPECIFY *KNU-VISE*
NEW *VERTICAL CYLINDER* CLAMPS

Tough, rugged and designed to do a man-sized clamping job—that's the *new* line of *vertical cylinder* air or oil operated clamps now being manufactured by Lapeer Knu-Vise.

The all new Heavy Duty AOV Series, features three basic sizes of 200, 400 and 800 lbs. clamping force respectively. Each size may be specified with either solid (inset) or channel toggle bars and spindle assembly (top).

Like all Knu-Vise products these powerful new vertical cylinder heavy-duty clamps were designed to give outstanding performance under the toughest manufacturing conditions. Such features as HARDENED AND GROUND BEARING BOLTS . . . HARDENED STEEL BUSHINGS . . . SELF-LOCKING NUTS FOR "TAKE-UP OF PLAY" . . . TOGGLE BARS MADE FROM COLD ROLLED STEEL . . . and EASY PARTS REPLACEMENT all assure you that when you specify Lapeer's KNU-VISE PRODUCTS you're "sending a man to do a man's job." Write today for complete information.

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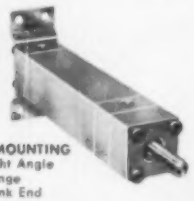
Parallel Base

NOPAK
CLASS 7 CYLINDERS
7 Universal Mountings
ONE BASIC BODY

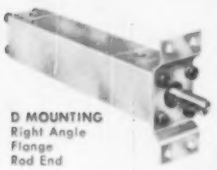
BB MOUNTING
Barrel Bolted

This is the only truly modular cylinder that is mass produced, yet gives you all the installation advantages of a custom-built unit. Any stroke length from 1" to 20" is immediately available in bores from ¾" to 3." Pressure rated for 200 p.s.i., air; 1000 p.s.i., oil, in the most popular stroke lengths.


C MOUNTING
Right Angle
Flange
Blank End

Roll 'em Over!

UNIQUE SQUARE BARREL†: Made of seamless extruded, aluminum alloy, drawn to a 16 micro inch finish, hard anodized to assure an extremely durable surface. Life tests reveal no wear in bore after millions of cycles. The four-square flush barrel provides unique and exclusive opportunity for direct bolt-in mounting into any of its sides or longitudinally from either end. (See Mounting HB & BB.)


D MOUNTING
Right Angle
Flange
Rod End

Blitz Bolt 'em!

NO TIE RODS! NO LOCK RINGS! All components including Mounting Attachments neatly contained by only four (4) bolts at each end.

E MOUNTING
Pivot Tongue

Shine 'em up!

STREAMLINED FLUSH FOUR SQUARE DESIGN — No tie rods; no humps; no bumps, no dirt catching, inaccessible, hard to clean contours.

F MOUNTING
Trunnion

Hang one on!

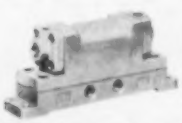
MOUNTINGS UNLIMITED: — The 5 Universal Mounting Attachments are quickly bolted to the basic body. In addition, the four-square design allows rotating and inter-mixing these attachments. Now add to this the exclusive Direct Head Bolt and Barrel Bolt Mountings and NOPAK Class 7 becomes the most universal air and hydraulic cylinder ever developed. A natural for even the most difficult applications.

HB MOUNTING
Head Bolted

Spin 'em Around!

CYLINDER HEADS: — as well as head plate, are precision cast and machined aluminum alloy. The four-square heads can be readily rotated to position ports for most convenient piping. No matter how rotated, the heads align perfectly with the square barrel, resulting in clean, flush surfaces. Heads also provide opportunity for direct bolt-in mounting. (See Mounting HB.)

Other NOPAK "CVA*" Products



NOPAK "V" 4-Way, Pilot Operated Slide Valves Small, compact, 3- and 4-way valves for direct or remote control. Either single or double air pilot or solenoid actuated. Simple, proven design, durable construction insure trouble-free operation.

NOPAK - MATIC Poppet Type, Pilot Operated Valves Fast acting, high volume air valves from ¼" to 1¼" with master (air piloted) single or double solenoid. Side or bottom ported sub-plates or manifolds. Removing cover plates affords easy access to piston poppets housed within removable, interchangeable cartridges. 100% J.I.C.

†Patent Pending

*Cylinders, Valves, Accessories. NOPAK offers a complete line of matched Fluid Power components.

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2750 S. 31st St., Milwaukee 46, Wis.

ENGINEERING BOOKSHELF

MAGNETIC CONTROL OF INDUSTRIAL MOTORS PART II: A-C MOTOR CONTROLLERS—By *Gerhart W. Heumann. John Wiley & Sons, Inc., 440 Park Ave. S., New York 16, N. Y. Price $9. 334 pages.*

With automation becoming increasingly dominant in the production of manufactured goods both here and abroad, control of electric motors has grown to a finely developed technique with which persons in charge of a production plant must become familiar.

The problem, basically, is not to design special controls, but to determine which type of commercial control best meets the specific needs of a given installation. The decision must be based on a fundamental understanding of the characteristics of each type of electric motor and on a comprehensive knowledge of available controls.

In this work the author first treats the three basic types of industrial a-c motors—squirrel-cage, wound-rotor, and synchronous—together with the types of controls available for each and the principles on which they operate; then he covers information applicable to all types: logic function and static switching, motor protection, and motor branch-circuit protection.

MANUFACTURING PROCESSES AND MATERIALS FOR ENGINEERS—*By L. E. Doyle, J. L. Morris, J. L. Leach and G. F. Schrader. Prentice-Hall, Inc., Englewood Cliffs, N. J. Price $15. 797 pages.*

To most engineers, manufacturing methods are a difficult discipline, acquired more or less haphazardly after graduating from engineering school and never truly mastered. The reason is that few schools provide an integrated program in the manufacturing end of the engineering profession.

While the situation is changing, the change comes slowly, and many young engineers are only superfically equipped to deal with manufacturing and production processes.

No one book, of course, could hope to fill this gap in the average engineering education, and indeed much of that gap should be filled with the aid of practical shop experience.

What this book does is to supply the engineering fundamentals on which

shop experience is based. It provides a unified guide to the understanding of the why and the how of the most common materials and the most often used manufacturing methods, with major emphasis on the why's, both engineering and economic.

MECHANICS—*By J. W. Breneman—McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. Third Edition. Price $5.50. 262 pages.*

Designed for the practical man who desires to increase his knowledge of engineering fundamentals, this book is a compromise between a purely theoretical course and a strictly practical compendium of data. The middle course that the author has chosen in his rewriting of this text continues to be based on practical considerations, but in all cases the solutions are based on fundamentals, which are repeatedly stressed so that the reader may develop the habit of logical reasoning and will seek intelligent solutions to his in-the-shop problems, based on the established fundamentals common to all engineering disciplines.

Mathematics are used, up to and including trigonometry, but calculus is purposely avoided so that a reader with a good high school mathematical background can follow the reasoning and master the information.

PATTERNMAKER'S MANUAL. *Second Edition—Published by American Foundrymen's Society, Des Plaines, Ill. Price $9.50 ($6.50 to AFS members). 406 pages.*

Casting remains one of the principal methods of producing metal shapes. But the techniques of casting have changed considerably in recent years. Processes which were used only for specialized work a few years ago now make mass production parts. Refinements of older techniques increase the precision of cast parts.

All this is reflected in the pattern, and in the new precision and refinement that is required of the patternmaker and of the engineer.

This second edition of an established standard work reflects the changes that have occurred in the casting art. While it contains much information specifically relating to the patternmaker in the performance of his task, the manufacturing engineer will gain from it a new insight into the possibilities—and limitations—of producing parts by casting, the ultimate purpose for which patterns are made.

ENGINEERING DATA FOR PRODUCT DESIGN—*By Douglas C. Greenwood. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. Price $10. 430 pages.*

There is much practical engineering ingenuity condensed in the average reference sheet published by most tech-

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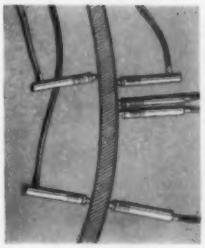
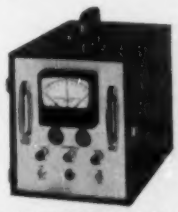


Uses Winslow Electronic Gaging Probes—sensitive transducers that substitute for standard dial indicators and most air probes in any mechanical "design" gage. Small size of the Probes (3/8" dia. x 2-13/32") allows locating check points where never possible before. Probes can be completely hidden. Console CS-24 (above) shows gage position and variation in lighted numerals 1" high, also prints this information on tape, card or sticker if desired. Push proper button to check any individual point, or machine automatically reads up to 24 gage positions and prints the results. Also reads "thickness" variation between any two opposed Probes. Accuracy possible to nearest .0001". Versatile—use with any number of "design" gages. Write for literature.

ALTERNATE READOUT DEVICES

Model IN-27 reads out a single Probe on meter scale. Can operate automatic sorting devices, etc. Can be ganged to read multiple points simultaneously.

Model LP-9 Electro-Chek* reads each of 9 Probes on the meter as you touch the button. Lighted digital lamp identifies gage position. Optional limit pointers.



Model LP-18 Electro-Chek* reads up to 18 contour points. Also reads "thickness" variation between any two opposed Probes. Compact. Versatile.

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nical periodicals, and much of it is lost as old issues of the magazine in which they appeared become more and more unavailable.

In this book the editor again makes available much "stuff that gives answers to the shirt-sleeved engineer" looking for a quick practical solution to an on-the-job problem. And, where the usual engineer's reference folder collects sheets haphazardly as they are published, this compilation puts order into that chaos by dividing the material under twelve headings from General Engineering to Hydraulics and Pneumatics, to put the information at the reader's finger tips.

A general table of contents, individual contents pages for each of the twelve sections, and a comprehensive Index facilitate the locating of the desired bit of engineering know-how.

INSTANT 2-WAY CONVERSION, INCH-MILLIMETER—*Published by E. Joe Penn, 4910 Carson Ave., Indianapolis 27, Ind. Price $1. 27 pages.*

Inch and millimeter equivalents are arranged side by side in increments of 0.001 inch and 0.1 millimeter. Range covered is from 0.001 inch to 10 inches. In addition, the forword includes tables to interpolate to 0.0001 inch and 0.01 millimeter increments.

Based on the international inch of 25.40000 mm, the conversion table fills a need generated by the new inch. One recurring error is in the abbreviation M.M. for millimeter. This should be mm, the symbol MM being used in most metric system countries to indicate 10 kilometers.

RUNNERLESS MOLDING—*By E. P. Moslo. Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. Price $4.95. 161 pages.*

Seventeenth in the series on plastics application, this book presents the general philosophy as well as a number of techniques for molding plastic parts without sprues.

Written by a recognized authority in the field, the book tells the technical story of how automation came to the plastic molding field.

Of special importance is the design of tools for runnerless molding, which runs like a theme all through the book.

CONVERSION FACTORS AND TABLES—*By O. T. Zimmerman and Irvin Lavine. Published by Industrial Research Services, Inc., Masonic Bldg., Dover, N. H. Third Edition. Price $7.50. 680 pages.*

New edition of a popular reference work, the book is one third larger than the second edition. Many conversion factors have been recaluculated on the basis of latest precision measurements of fundamental physical units.

FRICTION AND WEAR IN MACHINERY—*Published by The American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y. Price $7.50. 334 pages.*

Translated from the Russian with the aid of a grant from the National Science Foundation, this book contains 15 articles on friction and wear. Well-edited and displaying a depth of scholarship usually unseen in Western texts, this book requires a working knowledge of vector analysis and advanced thermodynamics as a prerequisite to its use. Though somewhat removed from the workaday problems of the practicing engineer, this translation should prove valuable in acquainting English-speaking researchers with the investigations of Soviet scientists in the field of machine friction and wear.

ENGINEERING COLLEGE RESEARCH REVIEW *1961—Edited by P. T. Bryant and J. F. Penn. Published by the Engineering College Research Council of the American Society for Engineering Education. Order from W. Leighton Collins, Secretary, ASEE, University of Illinois, Urbana, Ill. Price $4. 476 pages.*

A detailed listing of research programs now underway in the major engineering colleges in the United States.

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MONDIALE LATHES are precision-built for sustained accuracy and top efficiency.
MONDIALE LATHES are manufactured in 5 different models.
MONDIALE LATHES offer:
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Gallic #16	16"	—	16	2000	10/7.5
Celtic #12	12"	—	16	2000	3/2
Celtic #14	14"	21¼"	16	1600	3/2
Celtic #17	17"	25"	16	1350	6.5/4
Celtic #20	20"	30"	18	1000	6.5/4

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who's meeting and where

Nov. 2-3. AMERICAN ZINC INSTITUTE. Forty-fourth meeting of the galvanizers committee of the steel industry. Sheraton Hotel, Philadelphia, Pa.

Nov. 6-8. Atomic Industrial Forum called "Atomfair '61." Conrad Hilton Hotel, Chicago, Ill.

Nov. 7-9. Seventh conference on radio interference reduction and electronic compatibility, conducted by ARMOUR RESEARCH FOUNDATION. Requirements and problems pertaining to the Department of Defense Electromagnetic Compatibility program will be the main topics on the program. Illinois Institute of Technology, Chicago, Ill.

Nov. 7-10. AMERICAN NUCLEAR SOCIETY. Winter meeting. Conrad Hilton Hotel, Chicago, Ill.

Nov. 9-10. OPERATIONS RESEARCH SOCIETY OF AMERICA. Meeting. Jack Tar Hotel, San Francisco, Calif.

Nov. 9-13. SOCIETY OF AUTOMOTIVE ENGINEERS. National fuels and lubricants meeting, Shamrock Hotel, Houston, Tex.

Nov. 13-15. STEEL FOUNDERS' SOCIETY OF AMERICA. Technical and operating conference. Hotel Carter, Cleveland, Ohio.

Nov. 13-17. Worshop course entitled "Welding Fundamentals for Supervisors and Engineers." Arc welding procedures, principles and economical applications will be discussed and demonstrated. Hobart Brothers Technical School, Troy, Ohio.

Nov. 14-16. INSTITUTE OF RADIO ENGINEERS. Mid-America electronics conference. Kansas City, Mo.

Nov. 16. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION. Thirty-fifth annual meeting. Plaza Hotel, New York City, N. Y.

Nov. 18. SOCIETY OF CARBIDE ENGINEERS. Annual meeting. Belmont Plaza Hotel, New York City, N. Y.

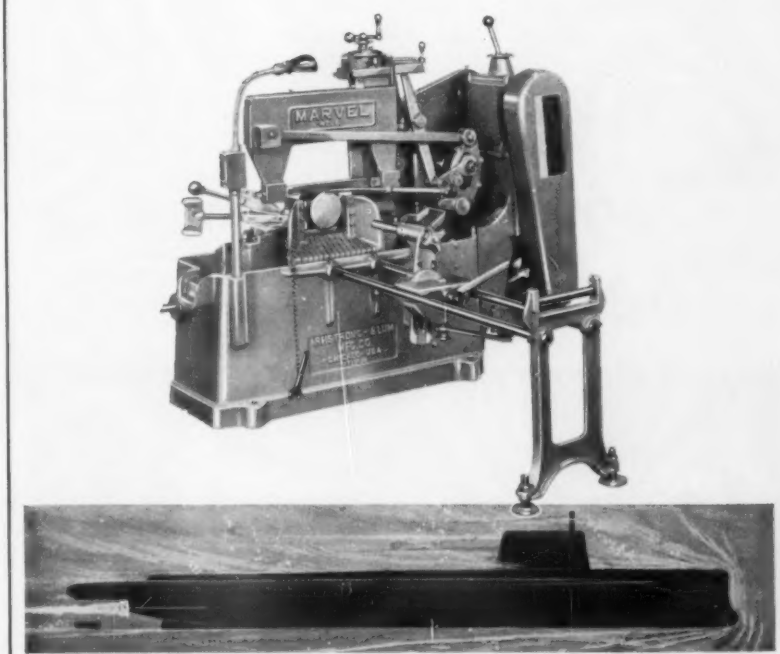
Nov. 26-Dec. 1. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Winter annual meeting. Statler Hilton Hotel, New York City, N. Y.

Nov. 27-29. PLUMBING BRASS INSTITUTE. Annual meeting, Savoy-Hilton Hotel, New York City, N. Y.

Nov. 27-Dec. 1. Workshop course entitled "Automatic Welding for Management." This will consist of a complete explanation of the requirements, in terms of equipment, for each process and an explanation of the electrical requirements. Hobart Brothers Technical School, Troy, Ohio.

Dec. 1. SOCIETY OF PLASTICS ENGINEERS. Regional technical conference on screw injection molding. Sheraton-Cleveland Hotel, Cleveland, Ohio.

Dec. 3-7. Eastern Joint Computer Conference. Sponsored by the INSTITUTE OF RADIO ENGINEERS, the AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS and the ASSOCIATION FOR COMPUTING MACHINERY. Sheraton-Park Hotel, Washington, D. C.



OBSOLETE ?

Emphatically no—not when a Marvel Hack Saw like this one can cut 4600 blanks of 3¼" round 303 stainless steel for just 1½ cents blade cost per cut—not when these 4600 blanks were cut-off at the rate of 20 pieces per hour, floor to floor! And this is typical production performance at that.

Obsolete? This Marvel Hack Saw Machine is as modern in performance as the next atomic powered submarine that will slide down the ways!

If you want faster cutting, the Marvel Hack Saw has speed to spare; accuracy of cut is assured by the rugged construction of the machine itself; blade cost, in many cases is less than 1¢ per cut.

When you consider these advantages and their low initial cost, Marvel No. 6 and No. 9 Series High Speed Heavy Duty Ball Bearing Hack Saws, as we build them, are your best cutting-off equipment buy today.

We can prove our point by demonstrating Marvel Sawing efficiency on your own work, without any obligation on your part. Because we have consistently built both Hack Saws and Band Saws for more than 40 years, we will give you an unbiased recommendation.

Catalog C-60 illustrates and describes the complete line of Marvel Sawing Machines. Write for your copy.

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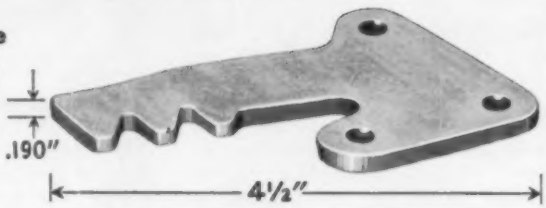
300,000 Blanks Stamped Between Regrinds . . .

"TRI-TUNG" Die Still Operating After 1,200,000 Stampings!



How would you like to stamp 300,000 parts like this, between regrinds? That's the kind of tool life reported by Ferro Stamping Co., Detroit, Mich., with Uddeholm's Fine Swedish Tool Steel.

These auto-door striker-plates were stamped from .190" Hot Rolled AISI 1010 steel plate, using Uddeholm "TRI-TUNG" (SAE D-6) for the four stage progressive die. "TRI-TUNG" is an Air Hardening High-Carbon, High-Chromium Swedish Tool Steel with excellent wear-resistant qualities.

To date, the "TRI-TUNG" die has produced 1,200,000 stampings . . . and is still going strong! This represents a 50% increase in die life compared with other High-Carbon, High-Chromium Steels. This results in considerably lower manufacturing and maintenance costs, — substantial cuts in down-time and reduced costs per piece.

Write for technical information and stocklist on any grade, size and type of Tool Steel you require.

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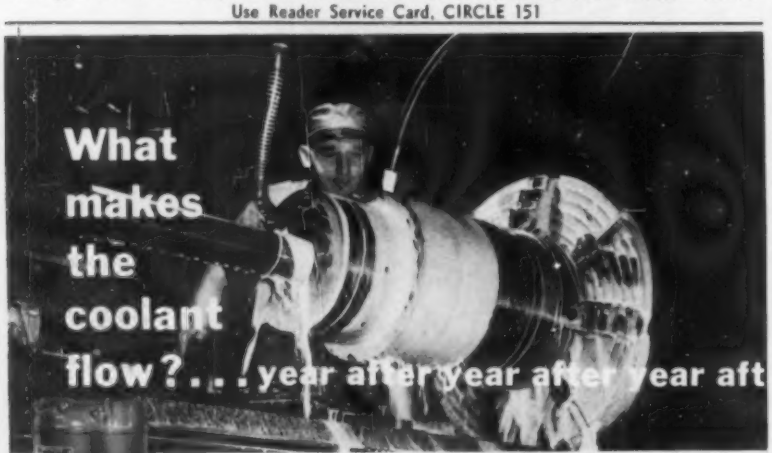

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.....readers' viewpoints

. . . creativity

To the Editor:

I read with great interest Mr. Greve's editorial in the July 1961 issue of THE TOOL AND MANUFACTURING ENGINEER. I would like to comment on his sentence, "There is no labor rate that cannot be offset by improved productivity," however. If this sentence read, "There is no labor rate that cannot be offset by improved product productivity," it would give direction to his "creative operation."

You do not breed for creativity nor do you educate or industry-train for creativity. Creativity—as it is used in this editorial—is synonymous with "constructive deviation from the normal or accepted."

Fortunately, however, in the last paragraph of "Looking Ahead," Dr. Maurice Nelles' accurate assessment of the national attitude toward research is recorded. Dr. Nelles' criticisms of the present fetish of following the normally accepted problem approach are well founded. This fetish lives and is well fed by management's abiding fear that an unhearalded individual might possibly provide creativity superior to that of committees—committees chosen not for creative ability but for the conventional thought patterns of their members.

Therefore, Mr. Greve's "path of no return to mediocrity" is distinctly attributable to management's desire for a peaceful and undisturbed life of paperwork in preference to the harsh realities of creative development.

In addition, it is considered almost unbecoming to honor industry's nonconformists—those who by their very nature must follow the truly creative path.

By way of constructive criticism, I suggest that we consider the national value of a change in the patent laws. The changes should be made to give the truly creative minds a little more incentive and a great deal more protection . . .

John Pearse
Swanton, Ohio

. . . gadgets contest

To the Editor:

Is the current Gadgets Contest open to everyone—or just to ASTME members?

Robert Carlson
Pittsburgh, Pa.

ASTME members only. Sorry—Ed.

Tech Digests

Machining Carbides, Hardened Steels, Heat-Resistant Alloys

Many materials formerly considered unmachinable are now being machined on a routine production basis. Any metal that is an electrical conductor, regardless of its hardness, can be machined by electrical discharge erosion or by electrochemical methods. Hard materials that are not electrical conductors, such as glass and ceramics, can be machined by the ultrasonic process.

In reference to my previous statement that I will talk about only the machine tools with which I am familiar, we will not go into detail concerning ultrasonic work, but consider some applications of the electrical discharge and electrochemical methods. Although both processes will machine hard and tough materials with ease, and will machine fragile sections, such as egg crate designs, without deformation, there are differences that would influence the selection of one or the other processes.

Electrical discharge machining holds close dimensional tolerances, produces a matte type finish and is quite simple to tool up. For the latter reason a single part or small-lot production runs can be machined economically by this method.

A low-cost conductive material such as brass is used for the tool or electrode, the machine producing an inverse image of the tool in the workpiece. High-current, low-voltage electrical impulses are employed, the cutting speed and finish produced depending on the power levels selected. The machining is performed while work and tool are submerged in a dielectric fluid. Some erosion of the tool occurs during the process.

In electrochemical machining the workpiece and the electrode are enclosed in a chamber through which a chemical solution flows. An electric current passing through the fluid from the workpiece to the electrode removes the metal. The rate of metal removal is governed by the amount of electric current applied and varies with the type of metal to be machined and the work area to be covered.

Tooling for the electrochemical process is a little more complicated than for electrical discharge machining because, in the former, the work area must be completely enclosed and the fluid must be directed to flow continuously through the cutting area. However, the electrochemical process removes metal faster. Therefore, for long production runs the added tooling cost could be a minor factor. Also, no erosion of the tool occurs during the machining operations.

From a paper "Points To Consider in Choosing Machine Tools for Production Requirements" by R. W. Ford, sales. manager, Machine Tool Div., Ex-Cell-O Corp., Detroit, Mich., presented at the Annual Machine Tool Electrification Forum, sponsored by the Westinghouse Electric Corp., Pittsburgh, Pa.

Machine Tool Export

Over the years, Westinghouse found that export sales are attractive from a profit standpoint as well as an equitable means of using excess plant capacity. Therefore, we are active in the export business and try to exploit every possibility to increase participation.

We think of export trade in a broader vein than merely selling manufactured products. In addition to marketing products, we are a principal proponent of selling "know-how" through license and technical agreements with foreign companies who are permitted to use our patents and obtain technical information for the design and manufacture of their products. To a lesser extent, another area in foreign trade is investments either in wholly owned endeavors or as minority owners in foreign concerns.

We believe that business in France, Italy, Brazil, or any foreign country should be done by local people. It's true we could probably do a better marketing job if we undertook to do all the selling ourselves. However, we would not obtain many other lasting benefits which we feel are derived from building strong trading companies in those growing markets. We support our distributors technically and provide training programs and other services so they can do a real marketing job and become recognized as strong business establisments of the highest integrity and stability. Most of our distributors become known as companies associated with American goods and services, because they usually represent more than one U. S. industrial company. As sales outlets for American goods, these local companies strive for standardization to U. S. methods and products. They become strong advocates for American technical advancements, and the use of U. S. standards in new programs in their countries.

From a paper "How Westinghouse Activities in Foreign Trade Help American Industry" by R. L. Jeans, vice president, Westinghouse Electric International Co., New York, N. Y., presented at the 25th Annual Machine Tool Electrification Forum; sponsored by the Westinghouse Electric Corp., Pittsburgh, Pa.

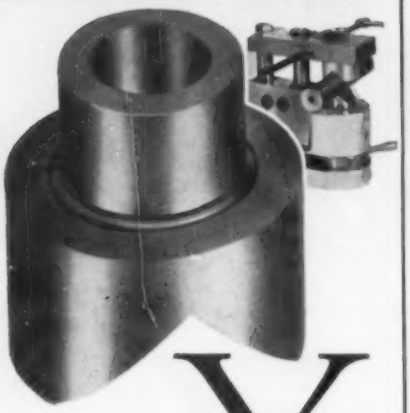
Economic Justification of Numerical Control

Do not establish justification on your present method of manufacturing, but rather compare your proposed numerical control method with the best known technique for producing a particular manufactured item. Too often most justifications are an "after-the-fact" type of effort; that is, the analysis is referenced to items now being produced.

Do not be misled. A justification based upon items already in production, or those which are far advanced in the production planning stages, does not permit you to give yourself or your managements a true evaluation.

Numerical control is not only a

NEW



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tech digests

manufacturing technique, it is also an engineering tool and a development tool as well. Only when it is considered in this way can a true evaluation be accomplished.

The development of justification for numerical control must consider that numerical control can be and is being used:

1. In the design, development and production of a new product
2. In the design, development and production of components for a new product
3. In the design, development and production of components to improve an existing product.

The complete cycle of any product from conceptual design to finalization is a long process requiring many different stages of effort and the building of several prototypes before the product is optimized and ready for market.

Normally, the first design is not satisfactory. Nevertheless, even if it is not optimum, certain elements and characteristics are acceptable. In numerical control these acceptable elements are retained and included in the second prototype. Usually, several designs and prototypes are made, each incorporating the best elements of the previous prototypes. Thus, the final production item is truly a composite of all prototypes.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

The current state of the art permits you to make use of numerical control in each phase—design, research and development, etc. Now by utilizing numerical control in each phase, the item is already described by points, equations or a combination of both. The numerical descriptions of the desirable elements are already in existence and are retained. In each of the developmental steps, the retained desirable elements are defined and therefore require no further effort to be described mathmatically. Only the revised portions require new definitions. Thus, the retention of desirable data combined with new definitions eliminates redundant effort. This applies to the total developmental cycle, and when the final design is accepted and proved, all the necessary requirements for immediate production are met.

Some results of this type of planning,

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METAL CUTTING PROBLEMS . . . .

This authoritative, informative bibliography is the latest, most up-to-date reference work on chip making processes available. Covers metal cutting literature from 1943 to 1956. More than 18,000 books, articles, papers in English and foreign languages reviewed by The John Crerar Library in Chicago, who compiled the book. Informative abstracts of 5,593 original works were prepared especially for this bibliography.

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and quite valid for your justification are:

1. The elimination of the heretofore "inevitable compromises" between design, research and development, tooling and manufacturing
2. The elimination of duplication of efforts between design, research and development, tooling and manufacturing
3. The resultant pyramiding of costs resulting from the duplication of effort are erased.

This permits an improved product or an entirely new product: in a shorter development time; in a production status in less time; a product ready for market sooner; at a lower total development cost; at a lower total product cost; and a product that can be sold at a lower price and still permit management a higher return on the dollars invested.

From a paper "The Economic Justification of Numerically Controlled Machine Tools" by Vance E. Rogers, numerical control consultant, Boeing Applied Computing Services, Boeing Airplane Co., Wichita, Kan., presented at the 25th Annual Machine Tool Electrification Forum, sponsored by Westinghouse Electric Corp., Pittsburgh, Pa.

Static Converter Drives

Static adjustable frequency power supplies built to date consist of a rectifier for converting fixed frequency a-c to d-c power, and an inverter to convert d-c into a-c power. The use of semiconductors for switching functions has so many advantages that it is practically universal. Semiconductors usable for this function are the power transistor and the controlled rectifier, with the controlled rectifier preferred especially at higher power levels.

Sequential gating of the semiconductor switches in a three-phase inverter requires a three-phase drive circuit, involving a low-power adjustable frequency reference source, driving logic circuitry including three pairs of "AND" gates, connected so that only one pair can be switched for each output pulse of the reference source.

By connecting diodes of opposite polarity in parallel with the semiconductor switches, power can flow through the inverter in either direction, while capacitors in the power supply output filter provide power absorption. An adjustable transformer connected between the inverter and the motor or between the primary power supply and the rectifier; silicon controlled rectifiers in the d-c supply; or saturable reactors can be used to vary the applied voltage with the motor speed. Modifying the timing of the gating signals applied to the inverter switches can also be used, but large departures of the voltage wave form from the sinusoidal impair motor speed stability and increase motor heating.

Squirrel cage induction and synchronous reluctance motors are often used, but their starting current may be as much as ten times rated current. As semiconductors cannot take these overloads, the converter may supply more than one motor and the motors are started sequentially, or the motors are started at reduced voltage, or hysteresis and special hybrid motors are used.

After three years of development, the broad objectives of the static converter program are close to realization. Circuit techniques have been developed and components have been evaluated. Future work will be aimed at reducing size and cost and increasing power output and frequency range of present designs.

From a paper "Static Converter Drives" by Lon Stringer and Ian Macdonald, Systems Control Dept., Westinghouse Electric Corp., Buffalo, N. Y., presented at the 25th Annual Machine Tool Electrificatiin Forum sponsored by Westinghouse Electric Corp., Pittsburgh, Pa.

something to look forward to....

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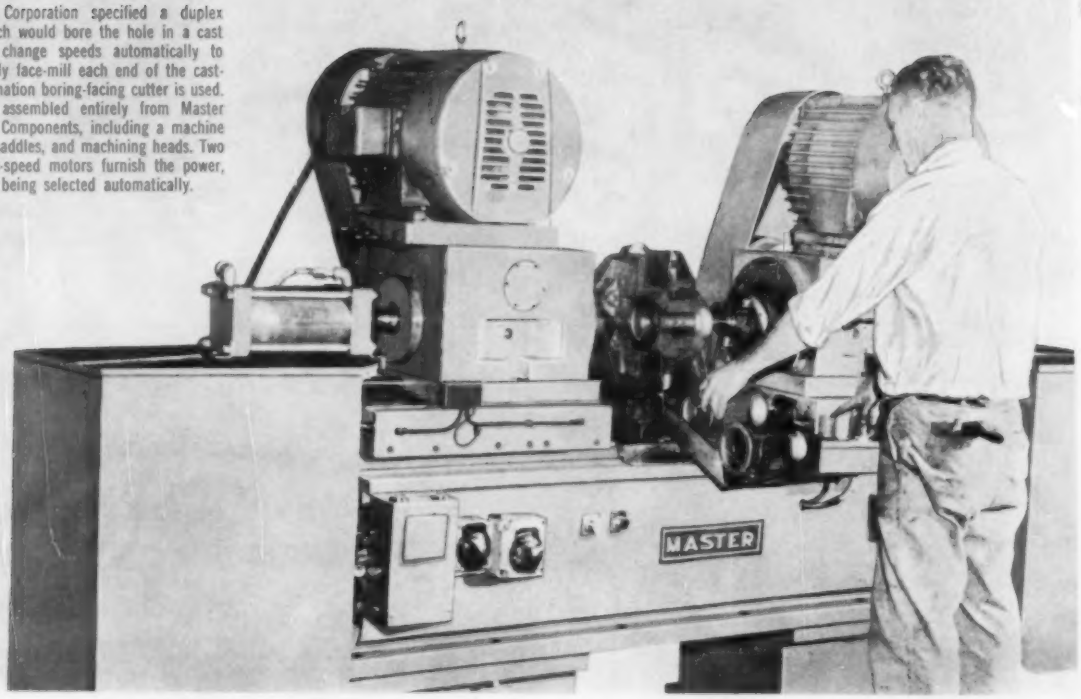
The Krause Corporation specified a duplex machine which would bore the hole in a cast spool, then change speeds automatically to simultaneously face-mill each end of the casting. A combination boring-facing cutter is used. Machine is assembled entirely from Master Erector-Type Components, including a machine bed, bases, saddles, and machining heads. Two 10 H.P., two-speed motors furnish the power, with speeds being selected automatically.



NOW BUILD VERSATILE,

- Inexpensive, off-the-shelf, building-block components make high-production-savings possible on small runs as well as mass production.

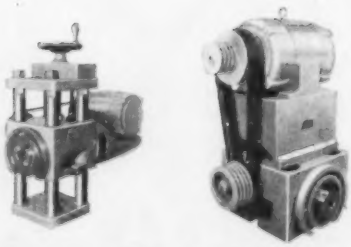
- Erector-Type components permit versatility of special machine design . . . let you add to set-ups or rearrange them as production requirements or part designs change. Master erector-type special machines never become obsolete.

- Simple erector-type machines, the inexpensive Master way, free standard machine tools for general purpose work.

- Master components can pay for themselves in price-part cost savings whether used for 3-shift production or occasionally.

- Master components are designed for rugged mass-production work, yet are precision-built to maintain the closest tolerances on intricate work.

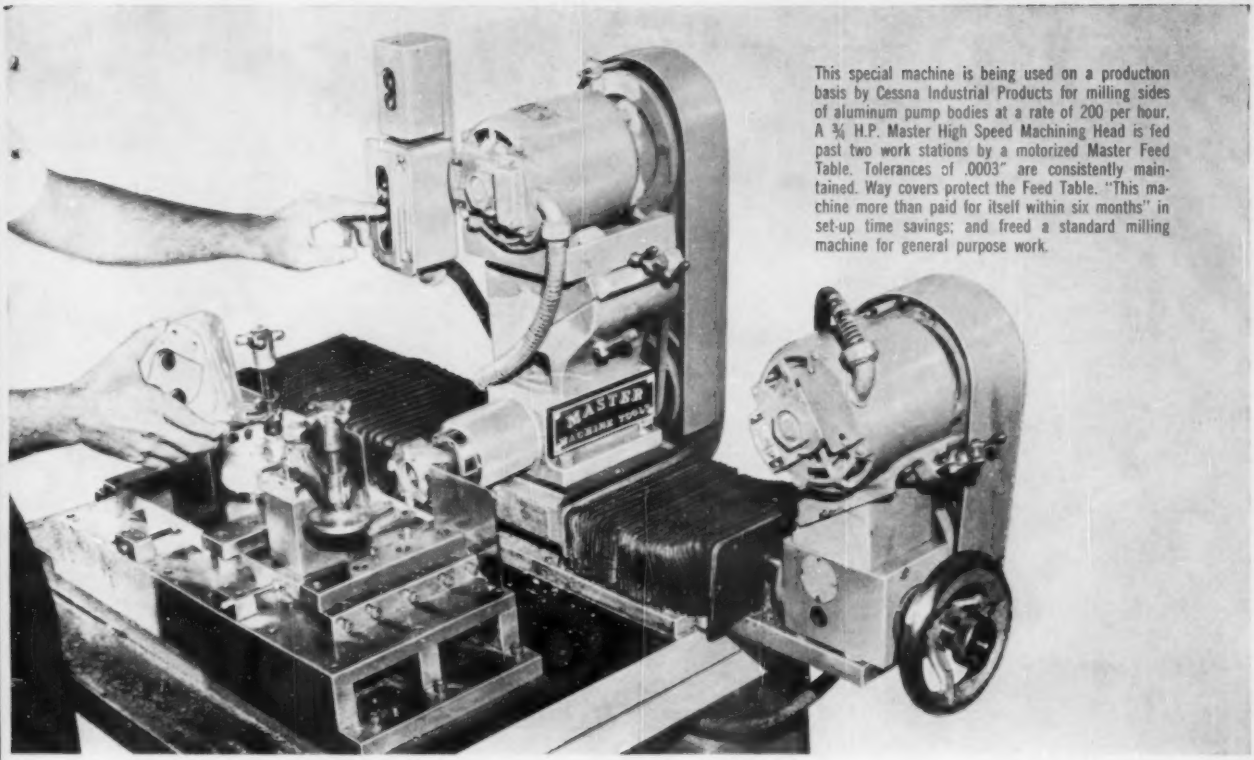
- Master components bring "transfer line" economies to any producer regardless of the size of your pocketbook.



BASIC MACHINING HEADS

5 models, ¾ to 20 hp capacity, in 144 standard sizes and styles give you a wide variety of automatic machining possibilities. Accessories increase tooling versatility.

USED BY HUNDREDS OF LEADING COMPANIES FOR THE PRIME PURPOSE OF REDUCING PER PIECE COST



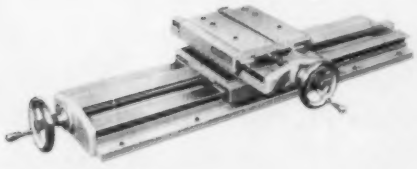
This special machine is being used on a production basis by Cessna Industrial Products for milling sides of aluminum pump bodies at a rate of 200 per hour. A ¾ H.P. Master High Speed Machining Head is fed past two work stations by a motorized Master Feed Table. Tolerances of .0003" are consistently maintained. Way covers protect the Feed Table. "This machine more than paid for itself within six months" in set-up time savings; and freed a standard milling machine for general purpose work.

LOW COST SPECIAL MACHINES...

...from

MASTER

ERECTOR-TYPE COMPONENTS



FEED TABLES

For positioning or feeding workpieces or Master Machining Heads. 5 basic models in several hundred standard sizes and styles provide travels from 3 to 198 inches. Hand or power feeds available. Hardened, replaceable ways optional.

MACHINE BEDS

Combine beds, work tables, wings and bases to build an infinite variety of foundations for multiple spindle machines. Units can be rearranged, added or deleted, to suit the tooling need. Hand or power feeds available.

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WHAT YOU CAN'T SEE CAN HURT YOU!

Most people can see and measure cutting tool wear (and prices). Many are watching frantically. But these are not the costs that hurt you. Cost of changing and setting tools in a machine easily can add up to eight times the cost of tool depreciation. These are hidden costs . . . but they are real. Do your shop people appreciate this? Tool budgets tell them to save tools. They do this by operating machines at uneconomical speeds. Profits go down the drain to make "paper clip" savings. Where is the emphasis in your plant? Tool life or least-cost production? Once people look through budgets to total tool replacement: (1) tool sharpening cost; (2) cost of tool change downtime; (3) tool resetting cost; and (4) tool depreciation, opportunities for cost reduction are obvious. Scully-Jones offers standard and special tooling to reduce **TWO** of these costs. In some cases, **ALL FOUR**. These tools can be applied to a variety of machines in your plant. They are designed to reduce hidden costs, which do not appear on a tool budget. They make higher machine speeds economical—reduce costs even with short tool life.

Scully-Jones and Company
1915 South Rockwell Street, Chicago 8, Illinois

SCULLY JONES

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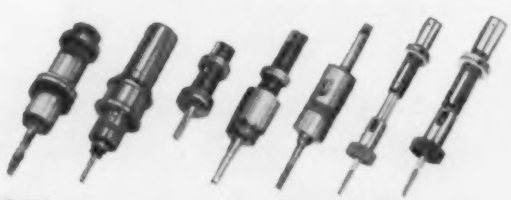

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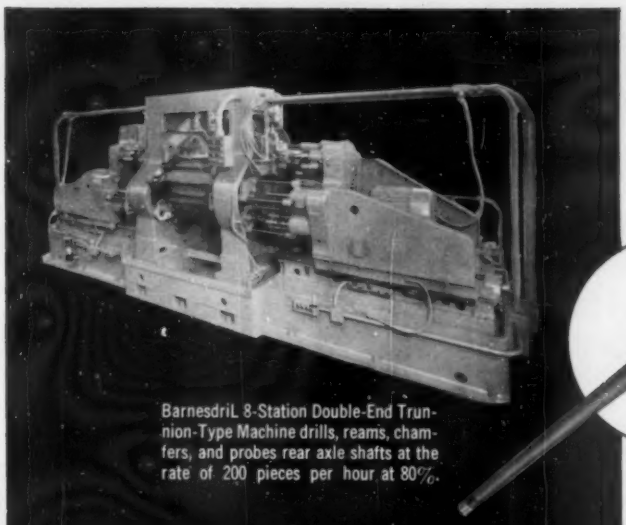
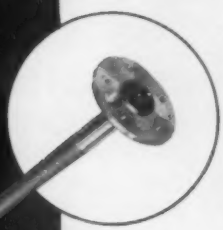
AGAIN...and AGAIN...and AGAIN BARNESDRIL ENGINEERS MEET THE CHALLENGE...

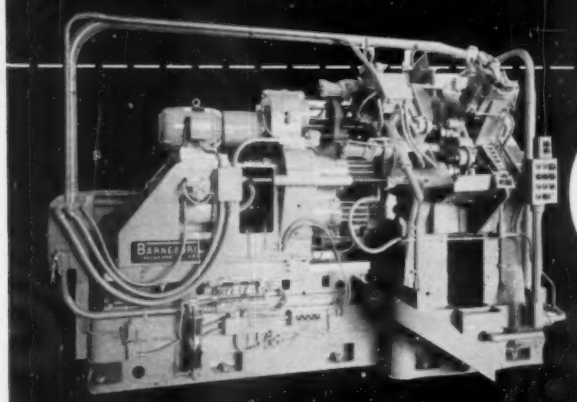


BarnesdriL 8-Station Double-End Trunnion-Type Machine drills, reams, chamfers, and probes rear axle shafts at the rate of 200 pieces per hour at 80%.

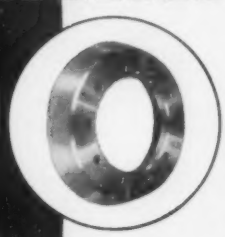


...TO SPEED PRODUCTION OF REAR AXLE SHAFTS

BarnesdriL's design improvement program led to the development of this 8-Station Trunnion-Type Machine. It produces as many rear axle shafts in one 8-hour shift as an older style Rotary Index Machine did in five 8-hour shifts.

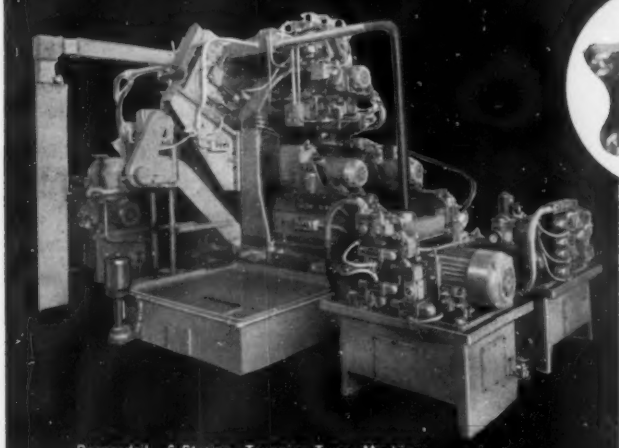


Special 8-Station Drum-Type Machine designed and built by Barnes Drill Co. for drilling, reaming, chamfering, tapping, and probing rear axle drive gears at 200 parts per hour at 80%.



...TO CUT COSTS ON REAR AXLE RING GEARS

This Drum-Type machine is a recent BarnesdriL engineering achievement to substantially increase production of ring gears for a large automobile company. Equally as important as increased production speed is the extreme tolerance accuracy and precision machining incorporated in this unit.



BarnesdriL 6-Station Trunnion-Type Machine performs drilling, threading spindle end, reaming, milling keyway, spot-facing, and probe operations on automotive steering knuckles at 208 pieces per hour at 80%.

...TO IMPROVE OUTPUT ON STEERING KNUCKLES

Another BarnesdriL Trunnion-Type Machine — a 6-Station Unit for machining steering knuckles. Application of a horizontal-type machine achieved more effective chip disposal, increased power through heavier construction, and higher speeds and feeds.

BarnesdriL's experience in designing and building special machinery is at your disposal.

Honing Machines/Production Units
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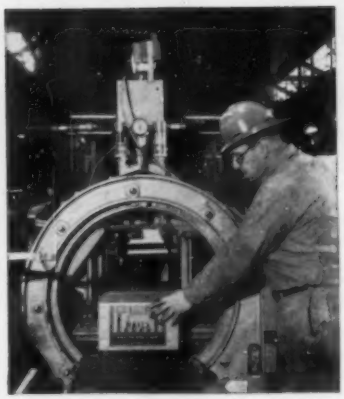
Use any actuation device — air, manual or electric. Rockford Pullmore Clutches start, stop, shift, reverse, inch, cycle and idle. They're used as main drives, auxiliary controls, and power take-offs for thousands of industrial machines. The Dual-Drive Clutches drive forward and reverse, attain high and low speeds, or control as clutch-brake combinations.

. . . FLEXIBLE DESIGN

High-torque compact design fits severe space limitations. Pullmore Clutches are available in single-drive or dual-drive units. The fast but smooth engaging clutches handle torque loads from 126 to 11,000 inch pounds . . . horsepower from 1 to 90 at 500 RPM. Sizes range from 1¾" to 8½" in diameter. Oil or dry operation. Write today for illustrated brochure.

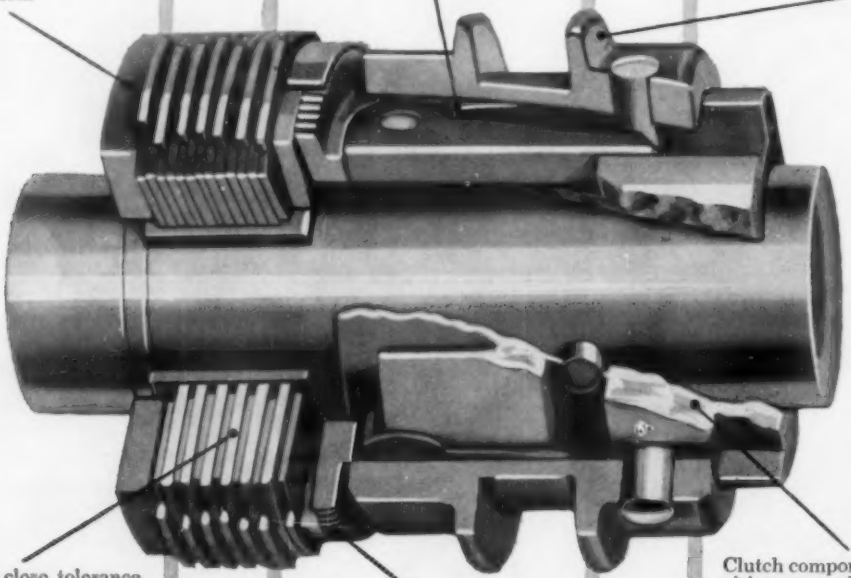


United States Steel Supply Model 12 Automatic Strapping Machine equipped with Rockford Dual-Drive Pullmore Clutch

Symmetrical design and precision machining assure smooth clutch operation. Torque is not affected by centrifugal force or direction of rotation.

Low axial pressure to levers gives positive, instantaneous engagement. High-ratio levers are case hardened forged steel. Immediate disengagement.

Use any actuation device — air, manual or electric. Slight pressure to shifting spool engages clutch. Spool length prevents binding and gives longer life.



Discs meet close tolerance flatness checks. Heat treated steel, graphite-impregnated bronze, sintered bronze or molded discs for oil and dry operation.

Easy Adjustment...simply raise locking spring and turn collar. Adjustment lasts for extra-long periods of heavy-duty service.

Clutch components are precision ground and highly concentric. Locking split ring assures positive axial positioning. Strong construction gives long, rugged clutch service.

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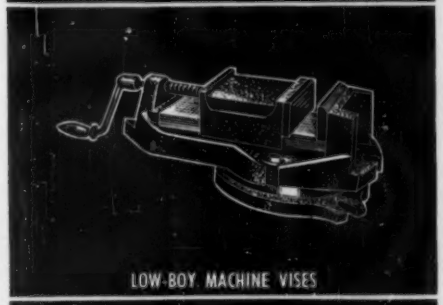
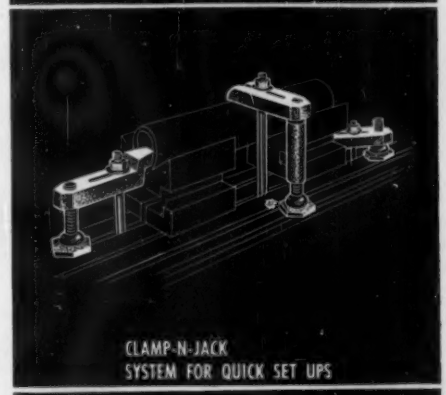
5 WAYS..... TO MAKE SET-UPS EASIER....QUICKER

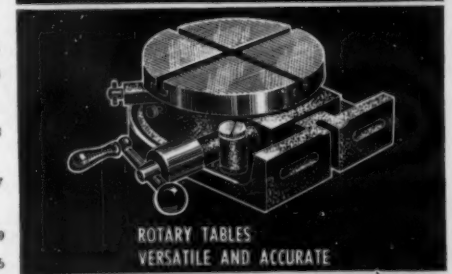
ADJUSTABLE ANGLE PLATES



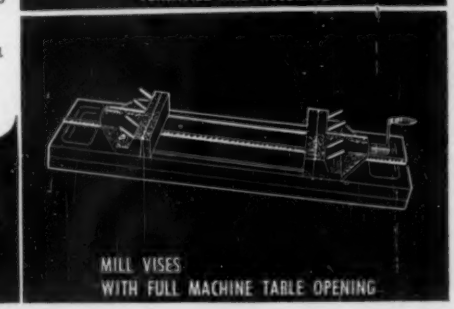
LOW-BOY MACHINE VISES



CLAMP-N-JACK
SYSTEM FOR QUICK SET UPS



ROTARY TABLES
VERSATILE AND ACCURATE



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Gierston Tool Co., Jamestown 4126
Lakeland Machine Tool Corp., Peekskill PE 7-2838
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Tool Crib Knoxville 5-6195

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Bill Lindsley Machinery Co., Dallas RI 7-1521
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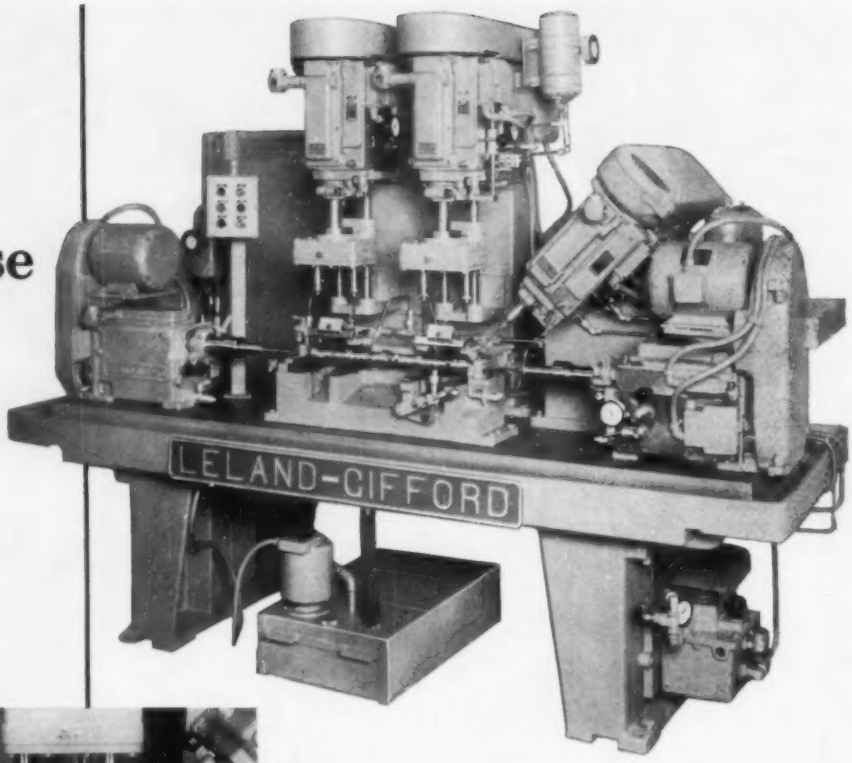
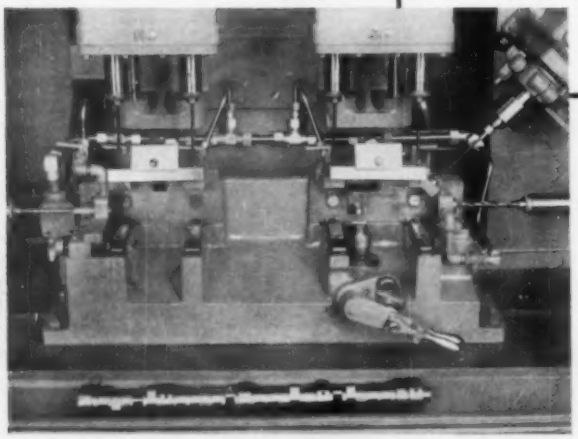
UNIVERSAL VISE & TOOL CO.
PARMA • MICHIGAN

Here's an idea you can use to cut precision drilling costs . . . .





One machine, one handling, one quick, simple operation does all the precision drilling on this camshaft. Note that this is not ordinary gang drilling — the job involves axial, angular and cross holes as well as reaming.

Leland-Gifford has time-saving, cost-cutting ideas for you, too — ways you can combine multiple operations into a simple, efficient unit operation.

THE JOB: Drill one end of camshaft and ream the other while drilling four cross holes and one angular oil hole.

THE MACHINE: A Leland-Gifford special with five No. 2 self-contained units and standard hydraulically clamped fixture interlocked with drilling units to start feed after clamping and to unclamp when operation is finished. SC units are interlocked to prevent interference between cross and axial drills. One operator completes 60 camshafts per hour at 100% efficiency.

For Automatic Drilling at its best be sure to see Leland-Gifford

Write for complete information — or ask to have an experienced sales engineer call.

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WORCESTER 1, MASSACHUSETTS
DRILLING MACHINES

for Strength
. . . Economy
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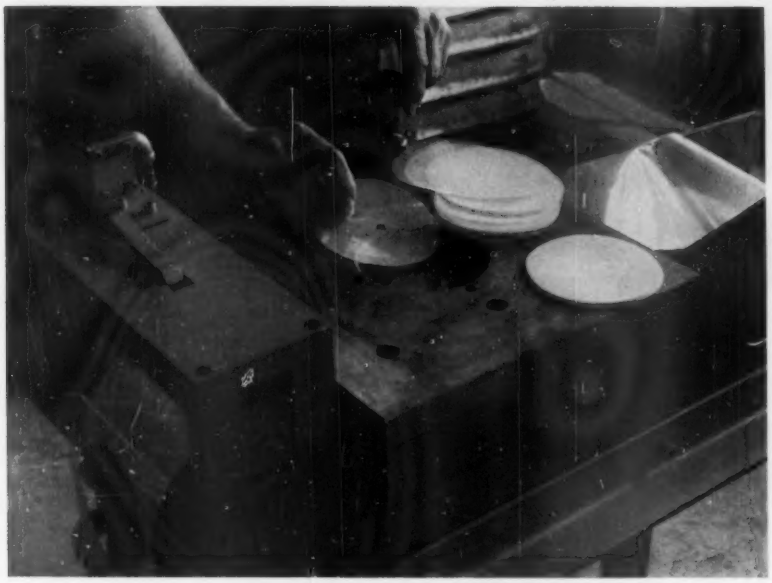
Tool Steel Topics

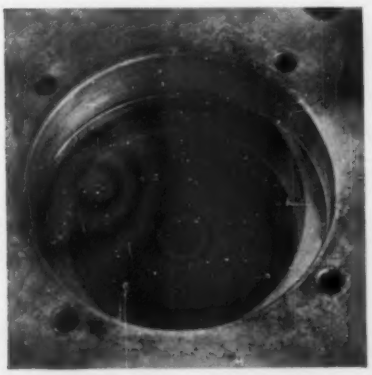
BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.



Seals for jet engine starter cartridges blanked with Lehigh H

The job was tricky. It involved cutting 6-in. circles from .002 in. Mylar, a plastic material used for vapor seals in jet engine starter cartridge parts because of its high strength and resistance to tearing. Bethlehem Lehigh H tool steel was selected by Seymour Manufacturing Co., Seymour, Indiana, who designed and built the die for Amoco Chemicals Corp. Lehigh H was a wise choice. The die, made to extremely close tolerances, blanked the material cleanly, and produced nearly 140,000 pieces before slight redressing was required.



Lehigh H (AISI D-2) is our easy-machining high-carbon, high-chrome grade of air-hardening tool steel. It has high compressive strength, deep hardenability, and excellent resistance to wear.

Lehigh H has wide range of metal working uses

Because of its ideal properties, Lehigh H is used for blanking, forming, punching, shearing, bending, and other tool and die jobs. It's frequently used for rotary slitting cutters, wearing plates, and thread-roller dies.

Good things happen when you put Lehigh H on the job. Your local Bethlehem tool steel distributor can make prompt delivery.

Call him today for complete details.

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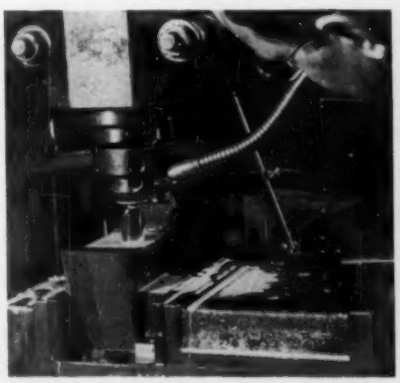
BETHLEHEM TOOL STEEL ENGINEER SAYS:

"Wear-In" of Tools Must Be Handled with Care

The initial use of new tools is the most critical period of operation. For example, during the "wear-in" period, the working surfaces of a drawing die and its mating punch may gall or "pick-up" portions of the metal being formed. This condition must be detected soon after it occurs, then removed promptly by hand stoning, to prevent further surface damage to the tools. If it is not detected and removed, heavy scoring and seizing may occur, producing not only short tool life but defective parts as well.

Obviously, the use of an effective lubricant will decrease "wear-in" problems, but even the best lubrication practice may not be sufficient protection on many operations. For example, a combination of tools and lubricant which performs well in processing soft steel may be troublesome in working stainless stock. Close attention to such tools during "wear-in" will delay the "wear-out" period.



Air-4 Tool Steel Machines with Ease.

Bethlehem Air-4 is a medium-alloy tool steel which hardens in air at 1550 F. It has excellent free-machining characteristics, due to a carefully controlled addition of lead. Air-4 also has plenty of wear-resistance, toughness, and deep-hardening properties. It can also be heat-treated without running any danger of cracking.

Photograph courtesy Anocut Engineering Company

what's new in

ELECTROMACHINING?

CHANCES ARE *you* know that electrodischarge and electrolytic machining make it possible to machine extremely hard materials such as tungsten carbide to extremely close tolerances. But did you know that these methods have now left the toolroom and are being widely used for production applications? ¶Did you know that the electrodischarge and electrolytic processes have been greatly improved during the past few years and that they have been joined by several other revolutionary new electromachining processes—electron beam machining, for example? Or that electrical energy is being used for parts forming? ¶If you want to know more about how these processes work, how they are being applied in other plants and how *you* can profitably apply them in *your* plant, we suggest that you attend the ASTME Creative Manufacturing Seminar "Electric Machining and Forming." ¶The time: Dec. 6-7, 1961. ¶The place: Statler-Hilton Hotel, Hartford, Conn. ¶Registration fee: $45 for ASTME members, $60 for others. ¶If you'd like to attend, we suggest that you register *now*. Send your check, payable to ASTME, to ASTME Creative Manufacturing Seminars, 10700 Puritan Ave., Detroit 38, Mich., with a letter telling us your name and mailing address.

ASTME CREATIVE MANUFACTURING SEMINARS HAVE THE ANSWERS!

J. F. McINTYRE tells why CALMEC always looks to Lindberg for heat treating equipment

Left, S. E. Summers, Chief Design Engineer and at right, J. F. McIntyre, Executive Vice-President, Calmec Manufacturing Company, Los Angeles. In the Middle, J. E. Krickl, Western Sales Manager, Lindberg Engineering Company.

"When we have heat treating problems we like to get the Lindberg man right in the middle of them. We know Lindberg men are heat treating experts and the best source we have for advice on the most practical and efficient equipment to satisfy any heat treating requirement. As a result we've bought lots of Lindberg equipment in the past few years. We like it and the fact that we are continuing to buy it proves that the Lindberg man's advice has been sound."

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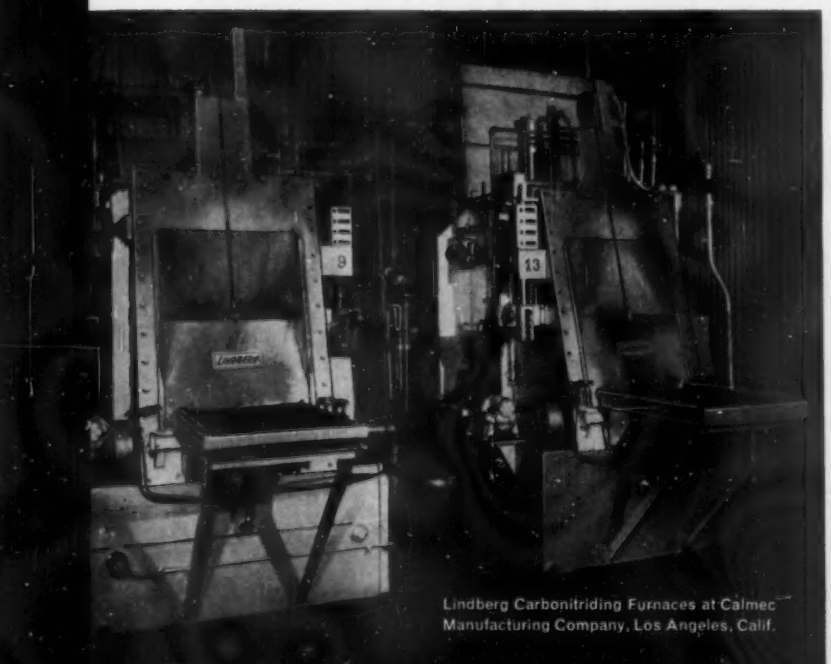

Lindberg Carbonitriding Furnaces at Calmec Manufacturing Company, Los Angeles, Calif.

Mr. McIntyre has certainly backed up the above words with deeds. Over the past few years, Calmec, a leading manufacturer of precision tools, parts and missile system components, has installed twelve electrically heated furnaces, six gas-fired furnaces and four atmosphere generators—all Lindberg! And we hope there are more to come. If you have any product or process in the metal or ceramic field requiring the application of heat it would be a good idea to get the Lindberg man in the middle right away. You can depend on his experienced help and Lindberg's engineering and design know-how to provide exactly the right equipment for your need. It's easy! Just get in touch with your Lindberg Field Engineer (see your classified phone book) or write us direct. Lindberg Engineering Company, 2447 West Hubbard Street, Chicago 12, Illinois.

Los Angeles plant: 11937 S. Regentview Avenue, Downey, California. In Canada: Birlefco-Lindberg Ltd., 15 Pelham Ave., Toronto 9, Ont. Also, Lindberg plants in Argentina, Australia, England, France, Italy, Japan, South Africa, Spain, Switzerland and West Germany.

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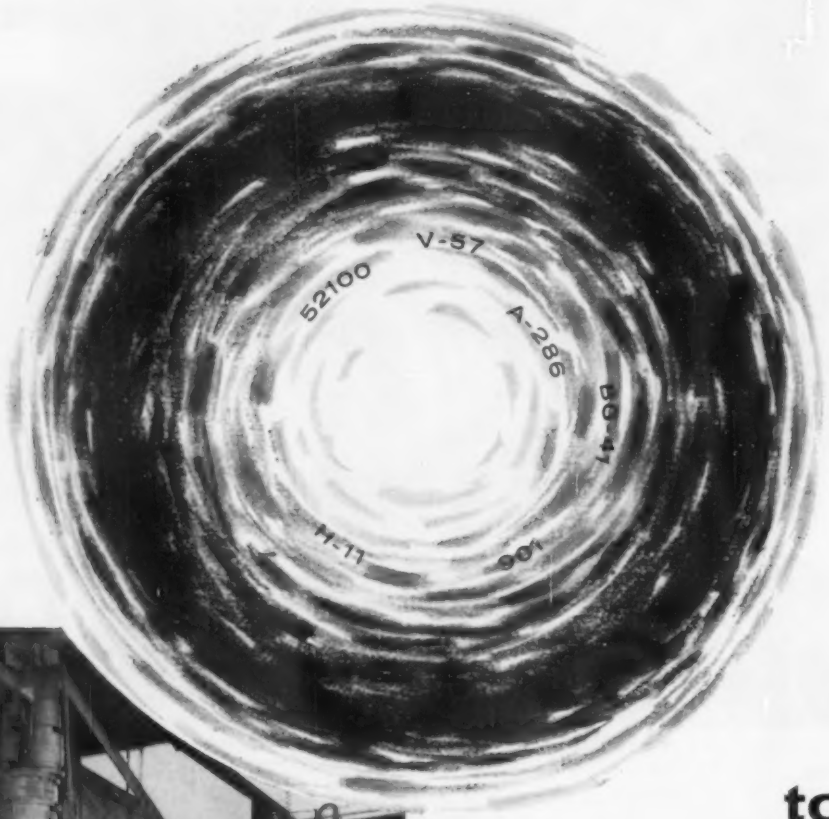
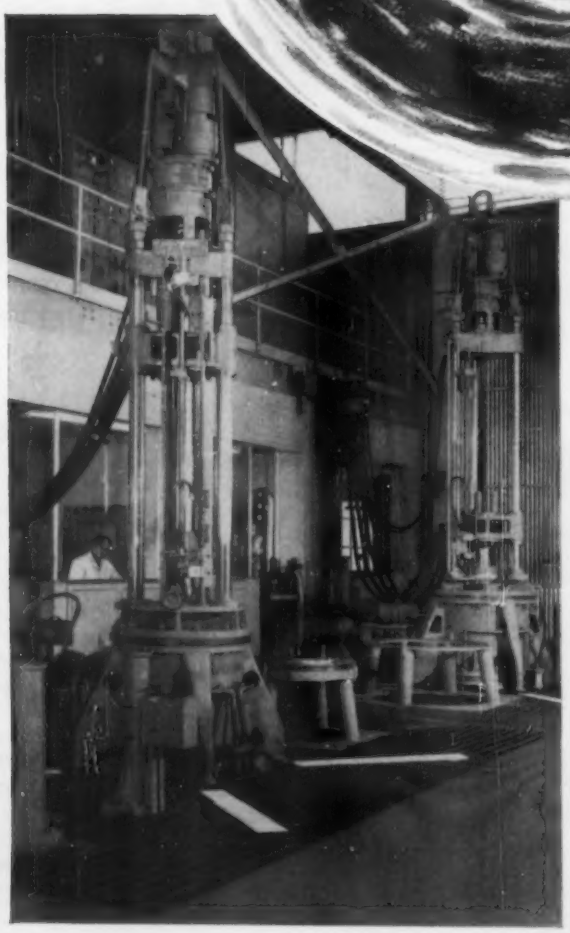
heat for industry

AT LATROBE . . . PROGRESS HAS THE GREEN LIGHT





PROGRESS MOVES FORWARD! CAPACITY MORE THAN DOUBLED! NEW 30" CONSUMABLE ELECTRODE FURNACE JOINS 20" UNIT.

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And supporting this technology is the know-how and experience of Latrobe Steel Company in specialty steel making . . . and its new, dynamic Vac-Arc furnaces keeping pace with tomorrow's fast moving developments.

Through modern vacuum melting techniques, these specially-engineered furnaces are creating high temperature and high strength alloys to new standards.

At Latrobe Steel . . . progress has the green light. If *you* have a problem in alloy application, we are anxious to help you. Latrobe Steel Company, Latrobe, Pennsylvania.

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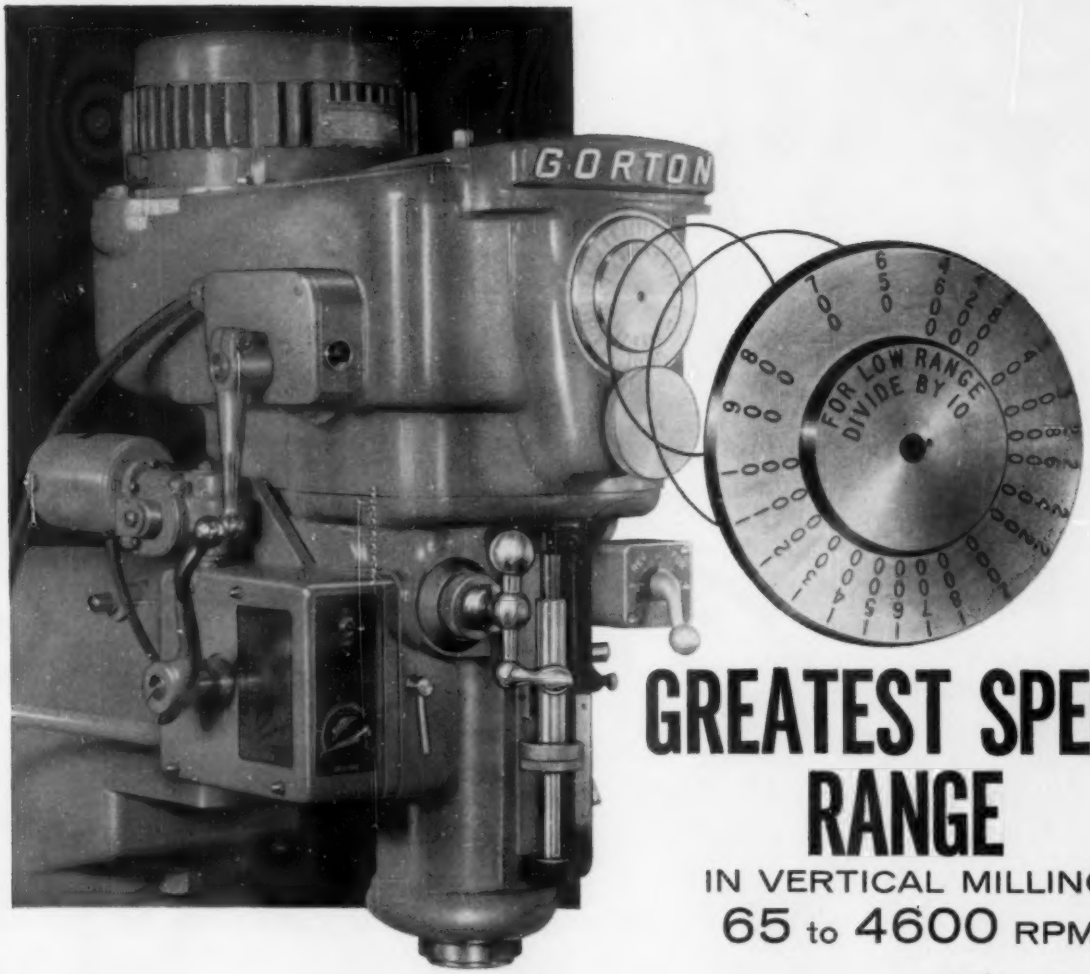

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IN VERTICAL MILLING
65 to 4600 RPM

New GORTON VARIABLE SPEED HEAD Model 1-22 Mastermil

- The ideal head for milling high tensile strength alloys with maximum cutter efficiency.
- Remarkably smooth spindle operation throughout entire speed range from 65 to 4,600 RPM . . . insured by *unison-mechanical* change of pulley diameters, with positive control.
- Guaranteed high precision spindle of interchangeable self-contained design.
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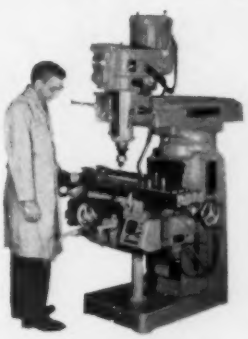
- Traditional GORTON quality in every detail.



Write for Bulletin No. 2699 for complete description of new variable speed head and Gorton Mastermil.

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Cushman also manufactures manually operated chucks, power wrenches, and floor plate jaws.

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YOUR ONE SOURCE SUPPLIER

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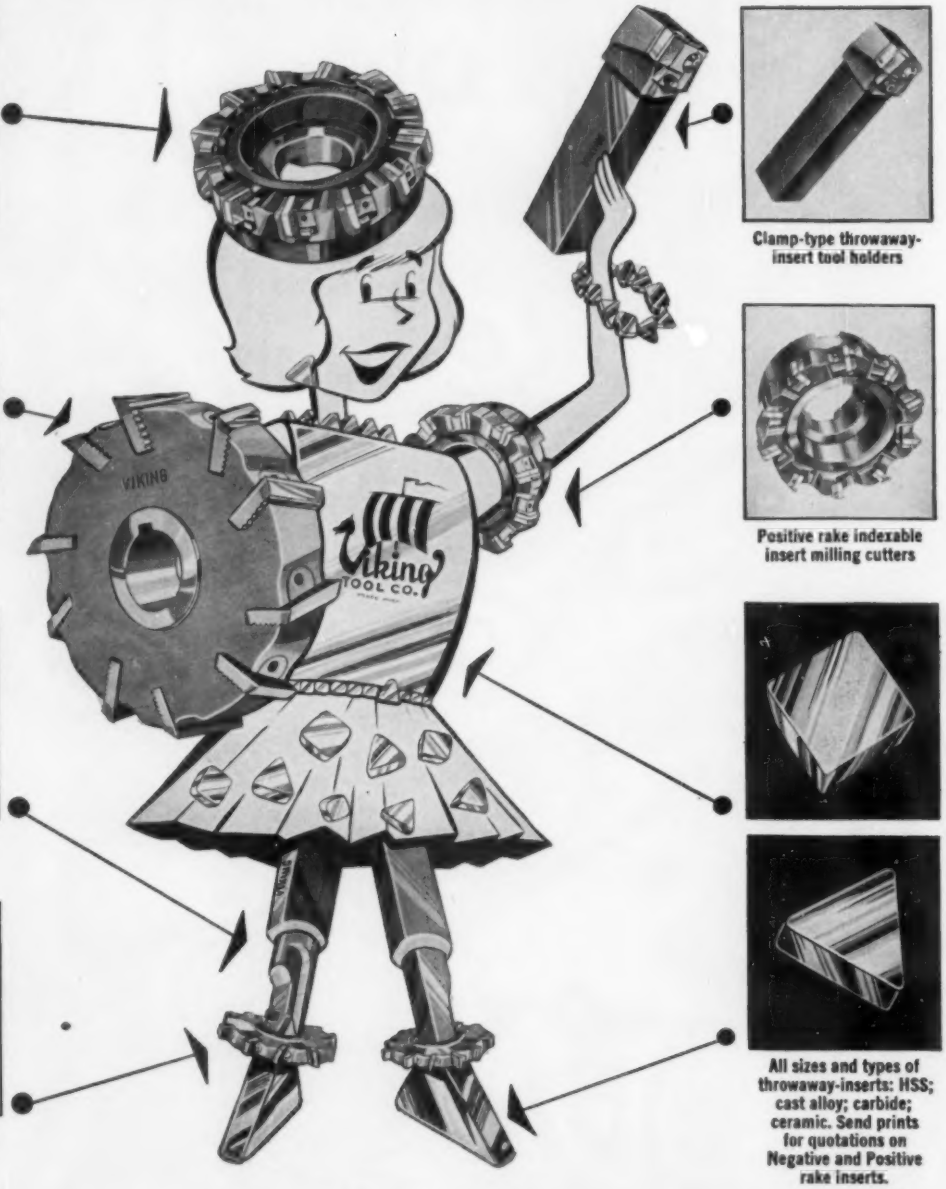

Clamp-type throwaway-insert tool holders

Positive rake indexable insert milling cutters

All sizes and types of throwaway-inserts: HSS; cast alloy; carbide; ceramic. Send prints for quotations on Negative and Positive rake inserts.

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The wise way to buy Carbide, High Speed Steel, Cast Alloy and Ceramic Throwaway-Inserts, and Tool Holders, Milling Cutters, and Boring Bars is to buy from one knowledgeable source. Viking tool engineers know the applications of not merely one of these items, but of *all* of them as they so vitally relate to each other in order to obtain maximum cutting performance with minimum loss in time and materials. Because Viking engineers are *pioneers in the throwaway-insert and tool industry*, they are uniquely able to recommend the right tool and/or insert for your particular need. They are at your service.

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Toolmaker Microscope

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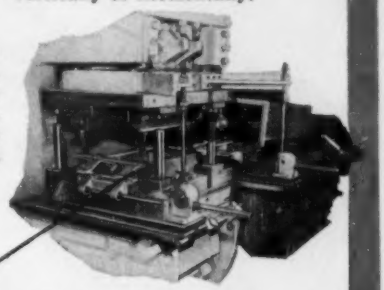
TRANSFER UNIT

is the right move in your —

Automation with LIVERNOIS Standard Transfer Units are easily incorporated in new designs to fit large or small presses. Move any part, any distance vertically or horizontally.

Die changeover is quickly made. Economical even for low volume production on new or existing equipment.



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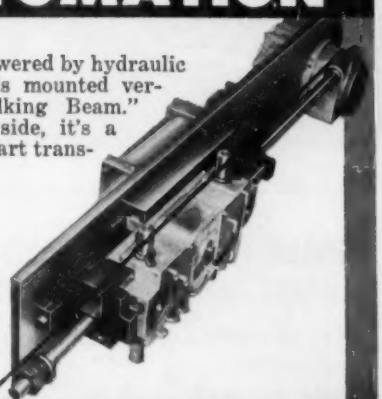
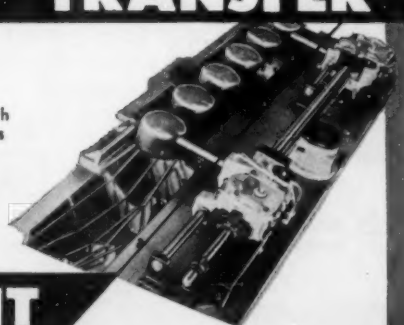
AUTOMATION

Standard unit powered by hydraulic or air cylinder is mounted vertically for "Walking Beam." Mounted on its side, it's a "Shuttle Type" part transfer unit.



There is a LIVERNOIS *Transfer Unit available for most applications*

TRANSFER



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Large cup trimming shows the "BUILDING BLOCK" arrangement using hydraulic power.

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That means fewer parts to get out of adjustment. And the one-piece frame and hub simplifies wear adjustment. Gives you greater accuracy, longer!

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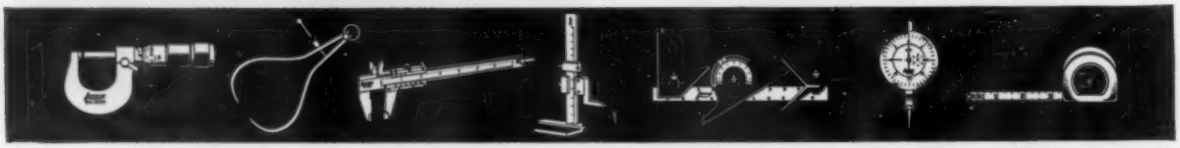

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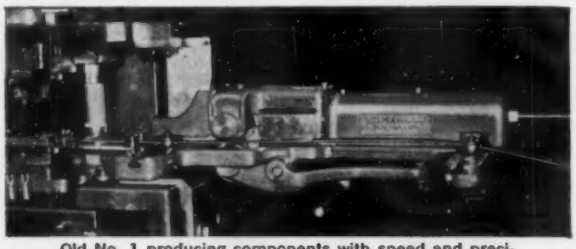

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Yes, Boyd Hayden & Company, Manufacturers of Textile Loom Harness Cords and Adjusters, purchased the first Dickerman 9" Rol-Di-Feed 11 years ago.

Weeks and months and years and many millions of trouble-free pieces later, this rugged press feed, Serial No. 1, was returned for servicing.

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In fact, many Dickerman customers with press feeds ten, twelve, fifteen and twenty years old say:

"Dickerman Feeds just don't wear out."

And, they don't.

Send for literature and prices on 15 standard "off-the-shelf" Dickerman Press Feeds.

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Perfect Seating Threaded ball permits easy removal of shoe

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by turning the eccentric pad is brought in line

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best yet!

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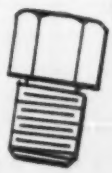

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Interchangeable Swivel Feet

SWIVEL FEET
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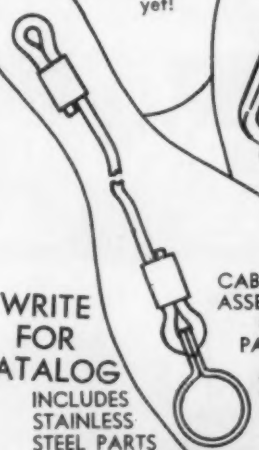

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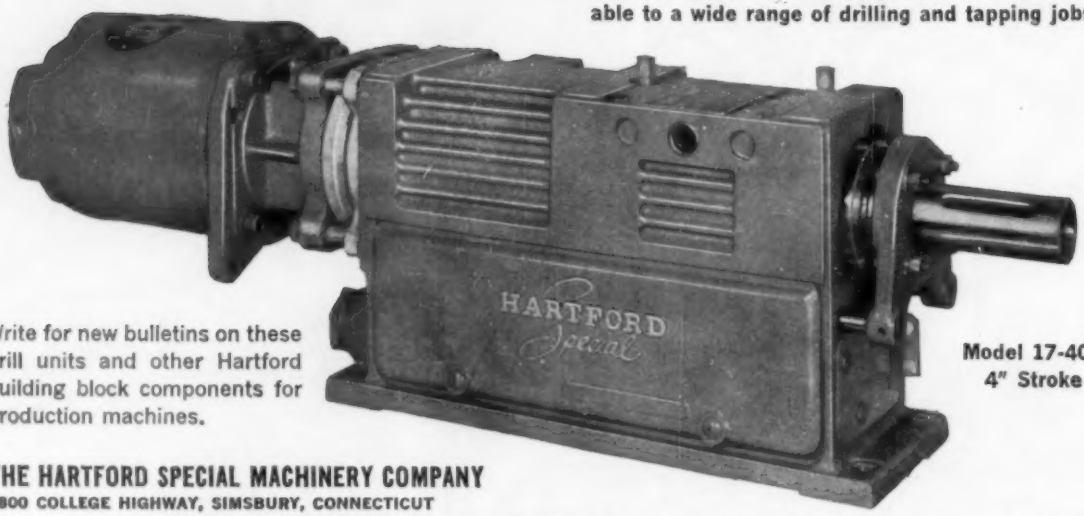
DRILL UNITS for VERSATILITY

Easy adjustment of feed rate and stroke length makes Hartford air-hydraulic units quickly adaptable to a wide range of drilling and tapping jobs.



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Model 17-400
4" Stroke

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▶ CUT TIME!
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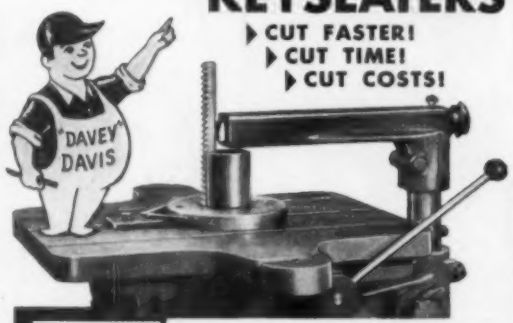

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SUPER SENSITIVE MU-6

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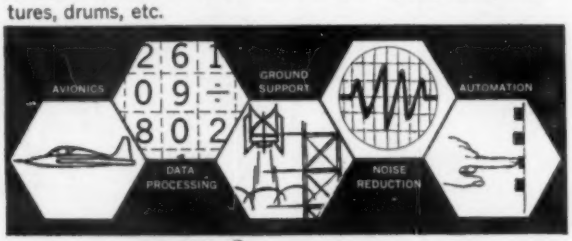
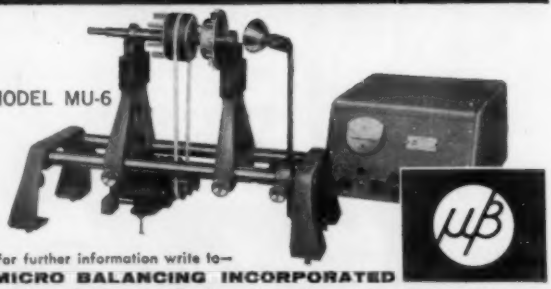
Dynamic Balancing

● High precision at no extra cost ● Sensitive to one micro-inch ● Balances over wide speed range ● Rotor weights up to 100 lbs. ● Use to balance-test rotors, impellers, armatures, drums, etc.





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MICRO BALANCING INCORPORATED
A subsidiary of Giannini Scientific Corporation
Herricks Rd., Garden City Park, L. I., New York
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Norgren PNEUMATIC PRODUCTS

COMPRESSED-AIR-LINE FILTERS

Norgren Filters are highly effective in removing water, oil, corrosive liquids, abrasive pipe scale, rust and other solids from compressed air . . . protect connected air-powered devices . . . improve performance . . . reduce maintenance and replacement costs. Choice of transparent or metal bowls or non-shattering, transparent "Safety Green" bowls . . . automatic or manual drain.

172 models in full range of sizes

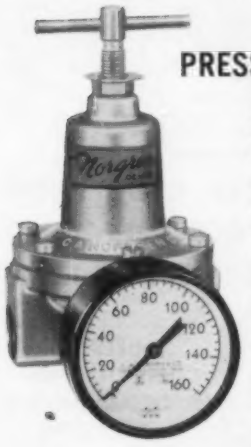
LUBRICATORS FOR AIR-TOOLS AND CYLINDERS

245 models

Norgren Oil-Fog and Micro-Fog Lubricators automatically provide a controlled fog of oil that coats and protects bearings and internal working parts of air-tools, air-cylinders and other air-actuated devices, improving performance and greatly reducing wear. Visible oil feed is easily adjustable to provide proper lubrication . . . shows that oil is being delivered. Visible oil supply.

Oil-Fog Lubricators

Micro-Fog Lubricators



PRESSURE REGULATORS

Norgren Pressure Regulators are available in a wide variety of sizes and types for air, water, oil, CO_2, L-P Gases and other non-corrosive gases and liquids. They reduce line pressure to the most efficient working pressure for the connected equipment and maintain that pressure in spite of fluctuations in primary pressure and rates of flow. Norgren Pressure Regulators give you superior performance because they are designed throughout for accurate, trouble-free service.

1591 standard models

NEW

Super-tough, non-shattering transparent Safety Green bowls.

NORGREN SAFETY GREEN BOWL

Non-shattering, impact-resistant transparent Safety Green bowls are optional on most current models of Norgren Filters and Lubricators and are available as replacements. They eliminate need for bowl guards or wire reinforcement . . . reduce bowl replacement costs . . . provide greater employee safety.

For a catalog, showing the complete Norgren line, call your nearby Norgren Representative, listed in your telephone directory — or write Factory for Catalog No. 1000.

FOUNDED IN 1925

C. A. NORGREN CO.

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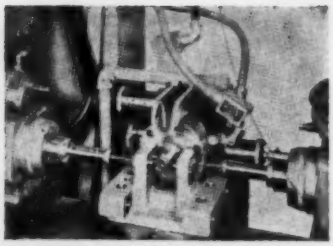
Angular accuracy within 2 minutes... repetitive accuracy in low "tenths" of a thousandth

ERICKSON INDEXERS–

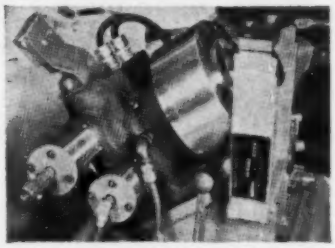
the economical way to smash automation bottlenecks

Even the most elaborate automatic production line can bog down *expensively* without rapid and accurate automatic parts positioning.

That's where Erickson Indexers really pay off. For you can interlock them into your production set-up with micro switches and solenoid valves. The hardened and ground lock pin operates in conjunction with the actuating mechanism to assure *positive positioning and angular accuracy within 2 minutes of a degree.* (Repetitive accuracy is no indication of angular accuracy. Erickson holds repetitive accuracy in low "tenths" of a thousandth.) And Erickson Indexers can maintain this great accuracy because their adjustable, self-contained shock control unit delivers a cushioned rotary load to the mechanism, thereby reducing wear.



Automatic drilling of cross holes being done on Erickson Model 400 Speed Indexer with air cylinder and Expanding Drawbar Mandrel. Indexer equipped with interlock limit switches.



Angular drilling in jet part held in air operated collet chuck on Erickson indexer operating automatically. Entire fixture designed and built by Erickson.

ERICKSON TOOL COMPANY

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COLLET CHUCKS • EXPANDING MANDRELS • AIR-OPERATED CHUCKS • FLOATING HOLDERS • TAP CHUCKS
• AUTOMATIC INDEXING • MASTER SPACERS • DIAPHRAGM CHUCKS • PUSH-ON ARBORS • QUICK-CHANGE HOLDERS
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• EXPANDING JAW MANDRELS • SPECIAL HOLDING FIXTURES (including gear-holding)
• BORING BARS • SPADE DRILLS • RECESSING TOOLS

Write for Catalog Section P today! You'll find many interesting applications for all Erickson holding tools. Take advantage of our free engineering service. An Erickson field engineer will gladly work with you for production economy.

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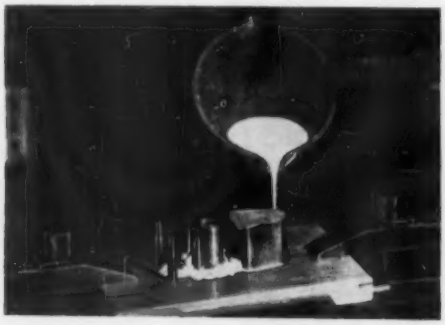
IN ANCHORING PUNCHES IN PUNCH PLATES



CERROTECHNICS — the technology of using CERRO* ALLOYS to expedite industrial operations.

Guided by die plate, punches are located in oversize holes in punch plate. Cap screws inserted into punch bases through auxiliary plate hold punches while CERROMATRIX is poured. Cuts costs 50% to 90%. Send for full information.

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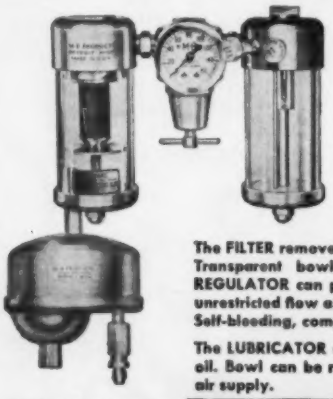
M·B

WHIRL-A-WAY FILTER, REGULATOR AND LUBRICATOR ASSEMBLY AND AUTOMATIC AIR TRAP (MODEL W-4)



SUCCESSFULLY USED FOR PROTECTION OF AIR VALVES CYLINDERS CONTROLS PNEUMATIC TOOLS, ETC.

The FILTER removes solids .00039 and larger. Transparent bowl provides visibility. The REGULATOR can pass large volume with an unrestricted flow and minimum pressure drop. Self-bleeding, compact.

The LUBRICATOR delivers desired volume of oil. Bowl can be refilled without shutting off air supply.

The Air Trap is automatic and eliminates manual draining.

M·B PRODUCTS
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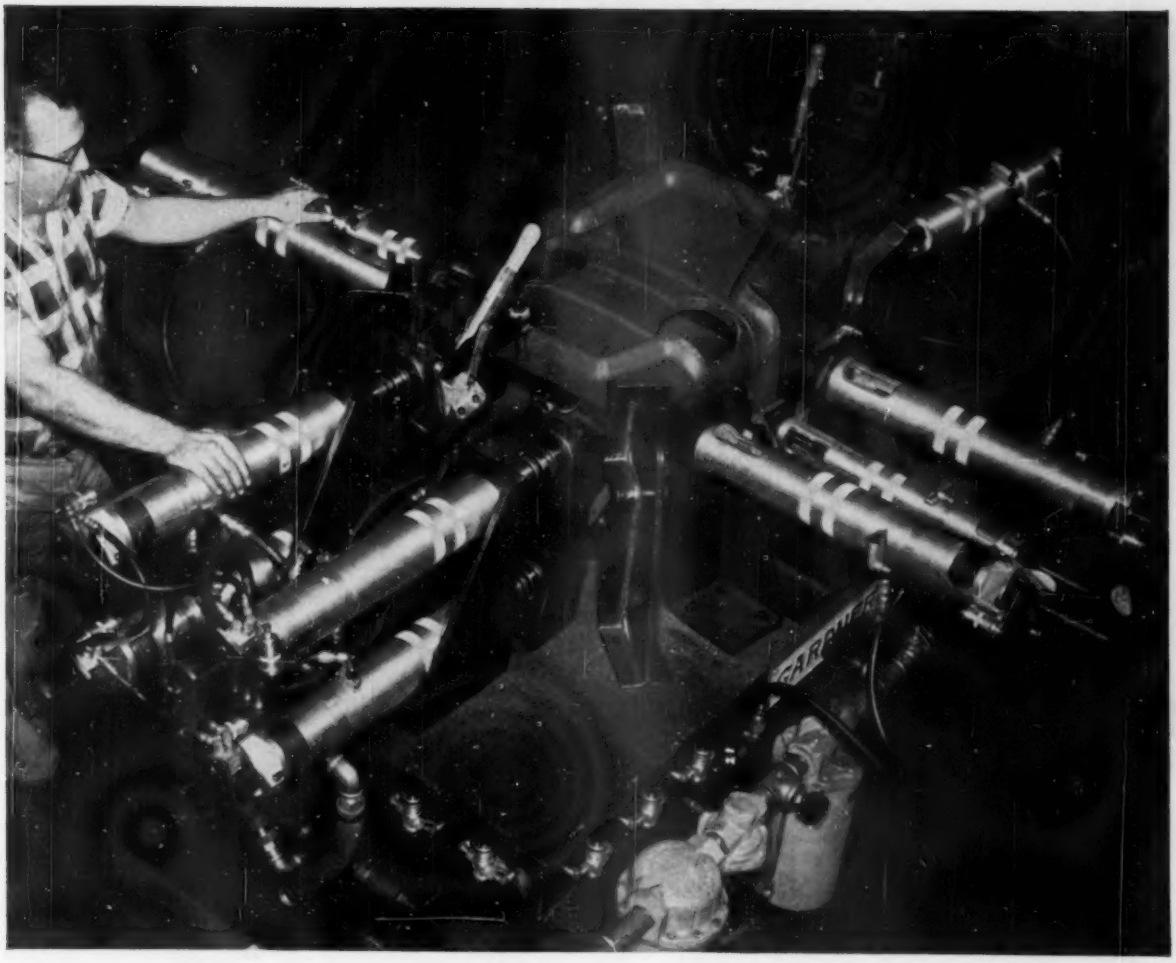

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Versatile Gardner-Denver "Airfeedrill"® units are easily adaptable to almost any drilling setup. You mount them as a drilling combination of two, 20 or more spindles for automatic hole processing. Use one as a stationary drill mounted on an inexpensive fixture. As a portable drill, "Airfeedrill" hangs by its nose to a jig for precision drilling.

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Portable Applications—"Airfeedrill" hangs by its nose to a jig for precision drilling.

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LOW COST PORTABLE ELECTRONIC GAGING UNIT

Now more compact, more versatile, easier to use . . .

Feather-light touch Extremely low contact pressure — less than 2.5 grams — so light you can gage dependably to high accuracies using test set stands or even more conveniently, the new, low cost wide range height stand illustrated.

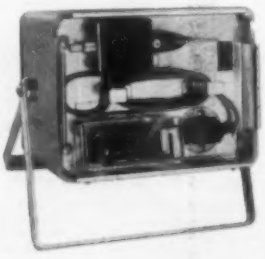
New Contact Tip Design New tip profile permits accurate measurements, without applying correction factors, even with finger at 20° angle to work.

Faster Zero-Setting Two-speed knob provides both long range electrical zero adjustment (over .008") and fine setting. Each Electro-probe has two ranges (±.002" and ±.001" for one model and ±.001" and ±.0002" for the other). Other magnifications available. Scales are correlated; zero setting will not change when switching magnification.

Battery Life Quadrupled New transistor amplifier design gets over 1200 hours life from mercury cell battery (up to 2 years normal use). Can also be operated from pen size mercury cells or regular carbon type batteries. For continuous use, a battery eliminator can be furnished for 115 volt operation.

Improved Meter Visibility Adjustable legs, which double as carrying handles, permit placing meter at any angle for best visibility. The fine line graduations and hair-line pointer provide easy, precise readings.

Completely self-contained Rugged meter housing contains all amplifier components (transistors and printed circuit card) so unit can be mounted in a panel if desired. When used as portable unit, gage head can be removed and mounted without disturbing plug connection, and back cover replaced while head is in use. Small plastic box within housing contains holding and mounting accessories.



Rear view with cover off.

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Ask **FEDERAL** *First*

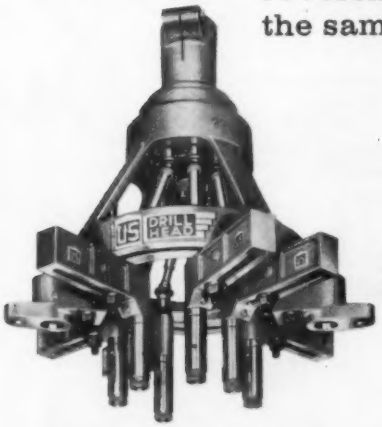
FOR RECOMMENDATIONS IN MODERN GAGES . . .

Dial Indicating, Air, Electric, or Electronic — for Inspecting, Measuring, Sorting, or Automation Gaging

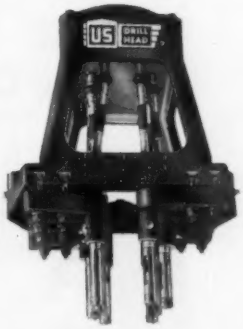
Quick-change deal...

or production runs . . . drilling only or drilling and tapping*. . . you can't beat the profit-making performance designed and built into universal adjustable **U.S. DRILL HEADS**

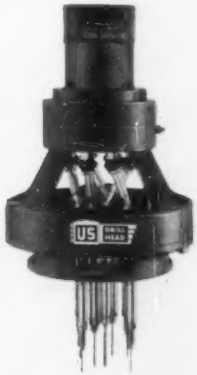
*When your drilling machine has a reversing spindle, you can drill and tap the same hole pattern with one head



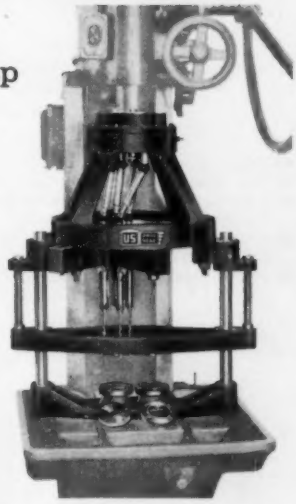
Style U Heads are built in 8 standard models — positive all-gear drive with shaved gears, antifriction bearings, and neoprene covered, lubricated quick-change joints—smooth, quiet, accurate.



Special head designs for single-purpose machines afford the flexibility of U. S. Drill Head's universal drives.



Slip Spindle Plates, used in place of the adjustable brackets, may be jig-bored to drill more than one pattern of holes.



Holding fixtures with guide bushing plates may be used for drilling two different workpieces at the same time, or to accommodate different hole patterns with a minimum of fixtures and setups. Guide bars maintain alignment.

US DRILL HEAD

Adjustable and Fixed Center Multiple Drilling Heads.
Individual Lead Screw Multiple Tapping Heads.

UNITED STATES DRILL HEAD CO.

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Model 4A Universal Turret Lathe

- Standard American Tooling
- Available in Bar or Chuck Machine
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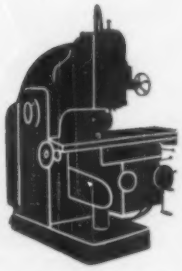
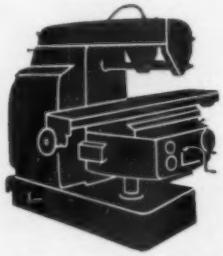
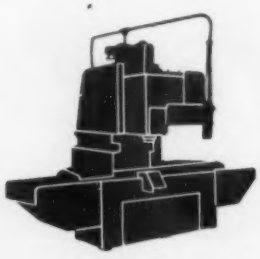
- 10 H.P. Motor



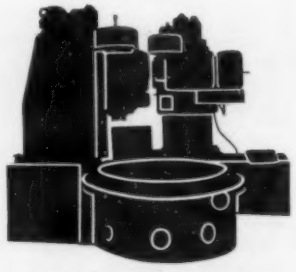
Medium Duty Milling Machine (Vertical Type)



Heavy Duty Milling Machine (Plain Type)



Production Milling Machine (Vertica Type)



Production Milling Machine (Rotary Table Type)

HITACHI SEIKI MACHINE TOOLS Tokyo Japan

Sole export agent: **HAKKO CO., LTD.** No. 555, Marunouchi Bldg., Tokyo, Japan.

For details, please write: **HAKKO CO., LTD (LOS ANGELES)** 4832, West Pico Blvd. Los Angeles, Calif. U.S.A.

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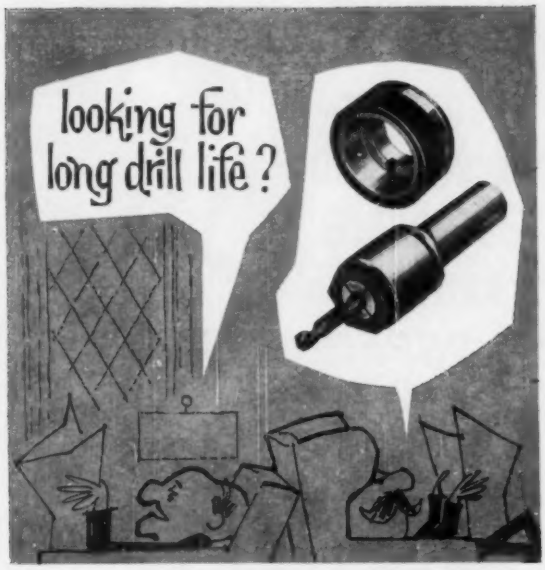

Stubbing makes drills stiffer—reduces chatter, increases tool life and productivity. New Scully-Jones "Stub-A-Long" chucks grip drills on shank or margin for locating and driving. Just stub up tools to required hole depth for vibration-free, straight drilling . . . without bushings. By presetting drills in chucks and using quick-ball-lock collars to speed changing, you can eliminate 80% of tool-change downtime on multiple-spindle machines. Write for literature.

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on any tapping job . . .
MORE PRODUCTION PER HOUR means LOWER COST for YOU with a

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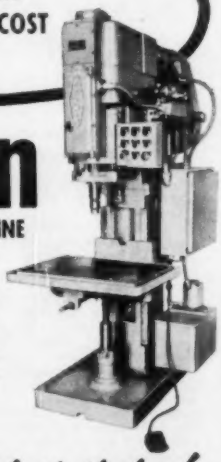
MODEL 10E-20 TAPPING MACHINE



More and more manufacturers are learning this fact from hour after hour, day after day, precision production tapping on the Kaufman 10E-20. With higher production, lower product cost, increased sales in mind — you, too, should learn all about the Kaufman 10E-20.

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UNIVERSAL BORE GAGE is a simple holder to which any "Last Word" type indicator can be attached. For checking bores, O-ring or snap ring grooves, thread reliefs, undercuts, etc. Range, with extensions, .200" to 6.000". Satin finish. With 4 pairs of points, wooden case, extensions, indicator. **$48.** Without indicator, **$24.**

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2", $4.	8", $10.	24", $52.
4", $6.	10", $15.	30", $65.
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FREE . . . new 1961 guide to "Time Savers for Tool Makers." It's packed with time and work-saving tools you can put to good use in your toolroom and production line. Write for your copy today.

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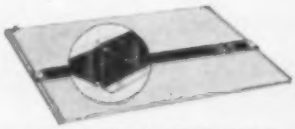
MAYLINE



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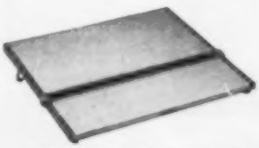
See your local dealer today and reserve the product you want. Early orders insure delivery for Christmas.



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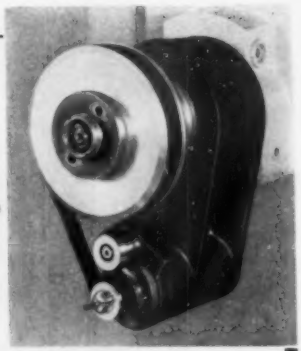

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- COMPACT—ELIMINATES UNNECESSARY BULK
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- SLIPLESS BELT TENSION ADJUSTMENT
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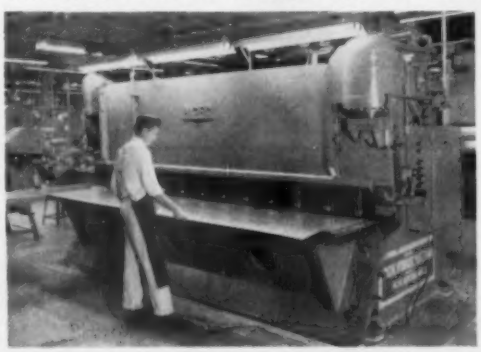
PACIFIC HYDRAULIC...THE VERSATILE SHEAR that cuts heavy plate or tissue-thin metal within thousandths of inch



Pacific Hydraulic is a general purpose shear handling a complete range of metal thicknesses within capacity. With both knife clearance and rake angle quickly and easily adjustable, shear can be used alternately for heavy duty plate work or fast, accurate shearing of thin sheet. At Alameda Naval Air Station, 3/8" Pacific Shear (above) is quickly set to .001" knife clearance for .005" sheet and reset rapidly and easily for cutting plate up to 3/8" thick. In any plant, large or small, a single Pacific Hydraulic will shear a complete range of metal thicknesses at substantial savings in capital investment and operating costs.

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. . . brings the ultimate within reach for users of self-opening stud drivers

A necessity where a limited amount of torque is desired—as in driving shoulder studs.

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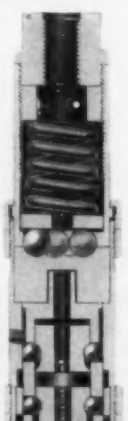

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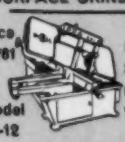

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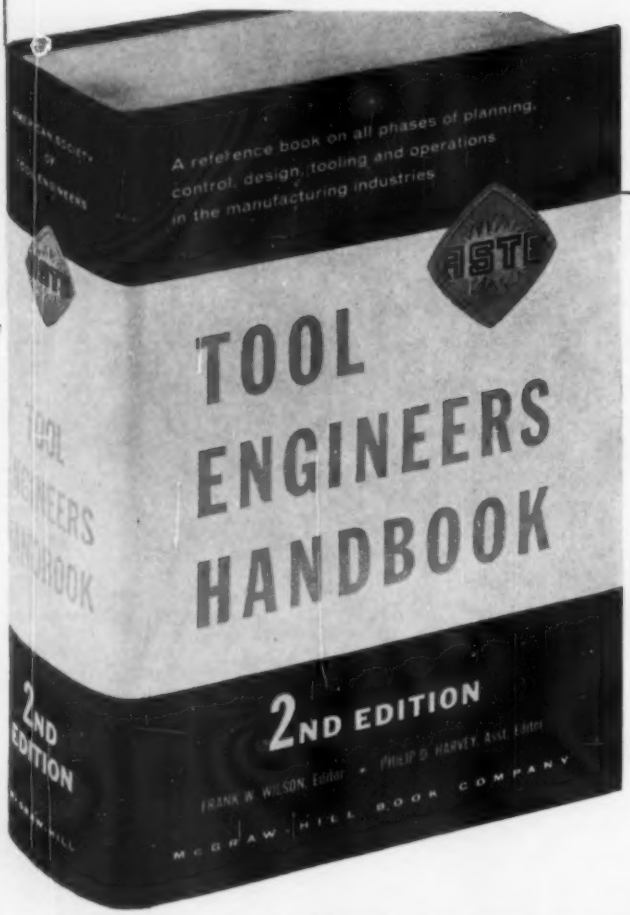
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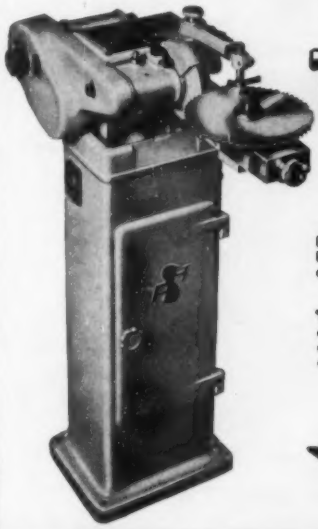

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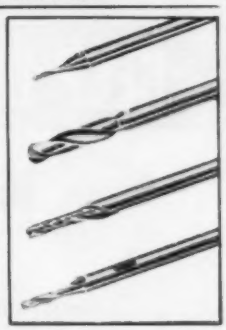

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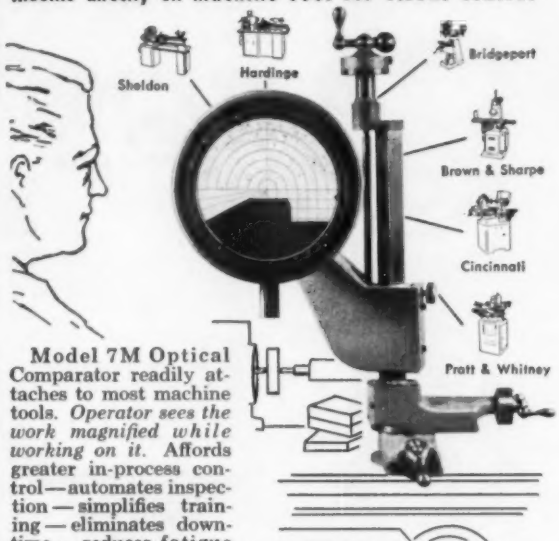

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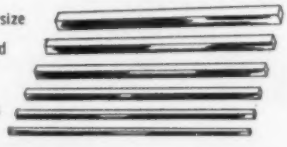

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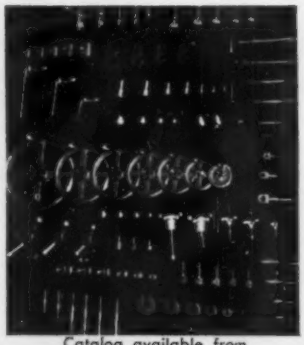

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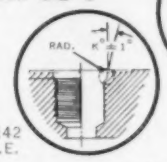

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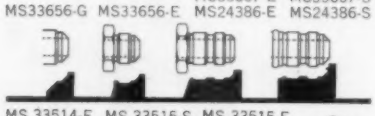

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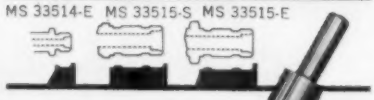

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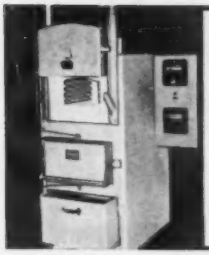

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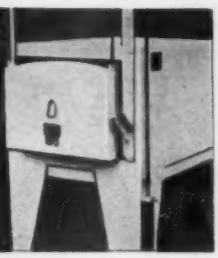

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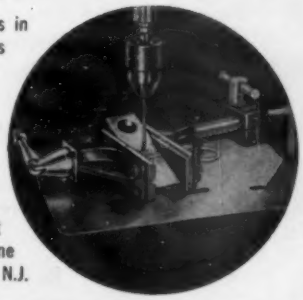

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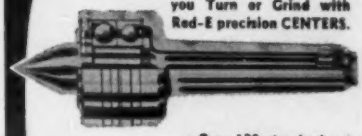

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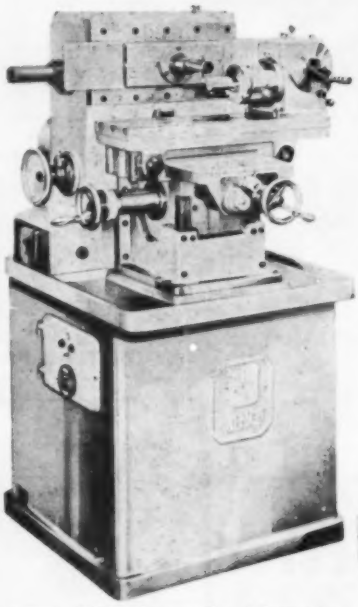

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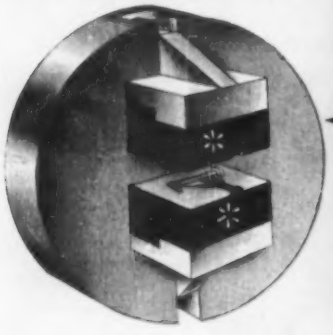

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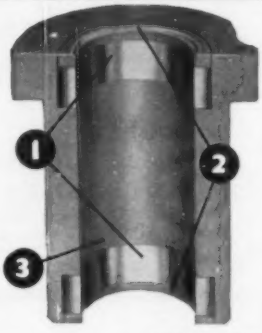

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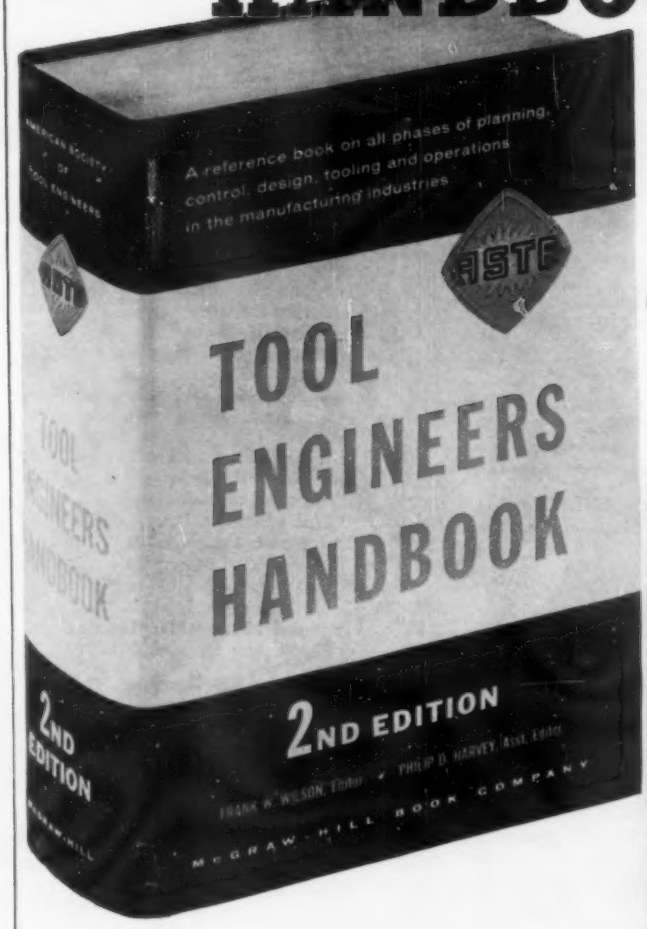
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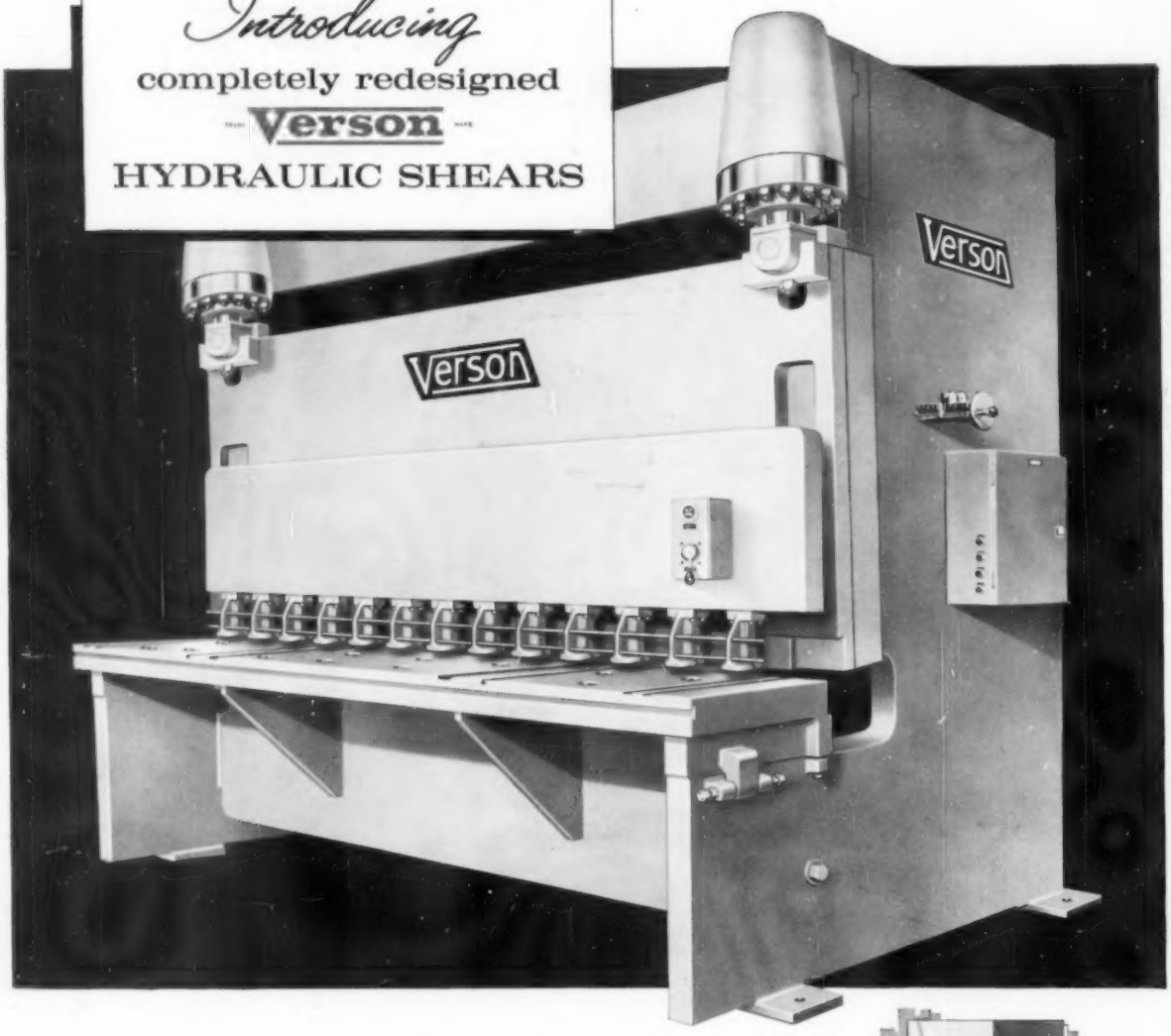

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